JOURNAL *of* FARM ECONOMICS

American Farm Economic Association Meeting
August 23-26, 1959
Ithaca, New York

THE AMERICAN FARM ECONOMIC ASSOCIATION

Volume XLI MAY, 1959 Number 2

CONTENTS *(Continued)*

Price: $9 per year, this issue $2.00

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P.L.&R., authorized November 27, 1931. Printed in U.S.A.

THE JOURNAL OF FARM ECONOMICS is published five times a year during February, May, August, November and December by The American Farm Economic Association. Yearly subscriptions $9. Published at Menasha, Wisconsin.

e for
1925,
J.S.A.
ruary,
socia-

JOURNAL OF FARM ECONOMICS

Volume XLI MAY, 1959 Number 2

ON AGRICULTURAL POLICY: A SYMPOSIUM

Editor's note: Most agricultural economists would agree that things are not well in the field of agricultural policy. Five persons were asked to comment briefly on past, current, and prospective developments. Their statements follow:

THE SUPPLY, PRICE, AND INCOME DILEMMA

MURRAY R. BENEDICT
University of California, Berkeley

IN A situation such as the current one, the agricultural economist concerned with policy has two problems—one, that of explaining behavior; the other, that of finding ways to deal with it. During the 1920's and 1930's, there was a good deal of emphasis on techniques for study of the demand side of the problem. That was logical, or at least understandable. It was part of the emerging interest in identifying and measuring the factors that influence prices and in finding ways to use that knowledge in the management of agricultural affairs. Supply was approached on the basis of crude assumptions or at least as not subject to control in any given situation. The programs of the 1930's did, of course, look to influencing supply but not in any precise or measurable way. This will be touched on later.

There were other reasons for the then prevalent emphasis on factors affecting demand, some of them less clear then than they are now. The major cause of low returns to agriculture in the 1920's and 1930's was weak demand, not excess production. The over-all trend of agricultural output had been surprisingly stable for at least two or three decades and not out of harmony with the growing needs of the country. Also, demand analysis is easier than supply analysis. Time lags are less of a problem, changes occur more frequently and, for many of the markets, central market and even national and international data can be used. In the efforts to analyze supply response, geographic differences and in fact individual farm differences are much more important as well as factors that involve motivation, timing of response and so on.

Be that as it may, the problems that have arisen in the 1950's have given new emphasis to analytical studies of the supply function. Note for example the series of articles in the November, 1958, issue of this *Journal* and in the Proceedings issue of December, 1958, and the numerous recent studies of individual farm adjustments to government programs. This again is a logical shift in emphasis. The overriding influence now is on the supply side, not on the demand side.

The changed situation is due largely to a technological revolution in American agriculture, probably the most spectacular change in the techniques of agricultural production the world has ever seen. We are still in the process of working our way out of the maladjustments created by this startling change in productivity of the factors, and the distortions resulting from wars.

While the major cause of farm distress in the 1930's was the enormous shrinkage in demand, the principal steps taken (in agriculture) looked to adjusting farm output to this reduced demand in such a way as to restore the price relationships of an earlier period. Obviously, a better solution would have been a quick restoration of consumer buying power, but that was not feasible by any known or acceptable procedure. Agricultural production was excessive in terms of existing market outlets, though not so much in excess as the legislative actions taken implied. If agricultural production could have been reduced enough to restore farm prices to parity, the result would have been merely to put the whole economy on a low-production basis and reduce living standards and over-all employment still further. Probably the steps taken went about as far as could be justified on broadly social grounds. It is not clear that, in terms of over-all well-being, farmers were significantly worse off than the general average of nonfarm people. The contrary view, often advanced, rests mainly on the use of prices as a measure of relative well-being, a most inadequate and misleading yardstick in a period when agricultural production was substantially maintained while industrial production and employment had fallen to extremely low levels.

Whatever their merits and effectiveness, the methods of production control devised in the 1930's are in the main the ones we are still using, but they are far less effective now than then. The primary control was on land which is, of course, only one of the factors of production. There was no effort to control capital or labor inputs or to hold technology constant. There was reason then to expect moderately good results from the approach used. Average yields of cotton, wheat, corn and various other crops, in terms of trend, had been almost constant for many decades. Presumably, if average acres could be taken out of production, the decrease in output should be roughly proportional to the number of acres idled.

But the stage was being set for something quite different. Soil conservation and soil improvement were taking hold in a major way; a vast reservoir of new technology was being built up. There was need only for the stimulus of high prices and unlimited outlets to trigger the remarkable upsurge in technological improvement and increased use of capital that marked the 1940's and 1950's. The war provided that stimulus and brought into effect incentives for increased production that continued almost unabated for 12 years. The strength of these incentives has been eased down only moderately in the years since then. There was not much real attempt to cut back production until 1953 and after, and that attempt was mainly by way of acreage controls—a brake that has obviously become inadequate for handling the enormously stronger engine that powers the modern agricultural production machine.

Acreage controls themselves, and other influences, have been rather astonishingly effective, but increased yields have more than offset them. Cotton acreage harvested was down to 11.9 million in 1958. It was 21.9 million (average) in the period 1947-1956 and had been as high as 44.6 million in 1926. Wheat acreage (harvested) was 53.6 million in 1958. It was up to 76.6 million in 1949. In 1958 we grew 30 per cent more corn on 73.5 million acres than we did on 110.5 million acres in 1932.

The space here available does not permit further analysis. The question posed is what can and should we do about it? It is significant that, despite the bitter political controversies and widespread criticism in respect to the current program, no widely acceptable and promising alternative has been put forward. The reason is clear. There is no quick and easy solution. We are still in the midst of a major technological revolution. Its momentum is such that it will be carried farther almost regardless of what we do. Once a large part of an industry has adopted new techniques, other parts have to follow, even if only to reduce losses rather than to increase profits. We'll have to live with this highly dynamic situation for some time to come.

The most troublesome problem is in wheat, and primarily in the hard red winter area. The current level of price support may not be such as to cause expansion, but it certainly is high enough to preclude rapid contraction. In the early years of the war, the Steagall amendment and other legislation which provided support at 85 per cent of parity were intended as strong stimuli to production, and they were. We'll have to put wheat supports lower if we want less wheat. One of the elements in supply response that has not been measured is the cost reduction resulting from the elimination of price risk. It is probably rather important. But the wheat areas have a perplexing and difficult problem. Much of the expansion was government sought and logical. There probably should be a fairly large-scale, regionally oriented, government-financed program to

reextensify and diversify agriculture in some of the wheat-growing areas. Such a program may serve also as insurance against the hardships which are almost certain to come to these areas when they again encounter a period of low rainfall.

In cotton the move toward a lower level of prices and a more vigorous effort to retain or recapture lost markets appears to be in the long-run interest of the industry itself. Possibly the severity of the adjustment should be cushioned by a gradual and planned removal of government supports accompanied by positive aid in shifting resources out of the industry. For the immediate future it appears likely there will be some re-expansion of output. It is not clear that outlets can be expanded enough to offset it. Hence, there may be some further build-up of CCC stocks.

Feed grains and livestock present one of the most perplexing of the problems. Government programs can be devised to help in stabilizing both feed supplies and livestock prices, but stabilization is not price raising. Here, as elsewhere, a major weakness in the farmer's argument is the continuing upward movement of land prices. Granted that there are many reasons for this, the fact remains that farmers are bidding more and more for the future returns from lands that are used for crop production. This raises serious question as to the adequacy of existing measures of the real content of agricultural income, a subject that is too complex for discussion here.

The other side of the problem is that of outlets for the excess quantities we do produce, whether by intention or as a result of circumstances. We'll have to be realistic about that. They are not going to be consumed domestically. They cannot be dumped onto the international markets in an unplanned way. They will not all be bought on a hard currency basis. Here, despite its undesirable features, I think we are likely to continue for some years to use something similar to the P. L. 480 procedure. But we could do a better job of it. We should recognize that we can't adjust quickly to a major technological revolution and should plan a gradual tapering off over a period of years. This will be done much better if laid out as a long-term program, in full cooperation with the recipient nations and with competing supplier countries, than if such procedures are forced on us by the exigencies of our own internal situation. Serious consideration should be given to fuller use of the soft currency funds so acquired as additional loan funds administered by way of the International Bank for Reconstruction and Development. Unfortunately, details cannot be spelled out here. The major emphasis should be on fairly long-term, well-planned and genuinely cooperative programs.

One further comment as to the outlook ahead. I do not share the view that the upsurge in production will continue at an accelerating pace. The record doesn't indicate that, despite the huge crops of 1958. These were

due more largely to weather than to increased inputs or continuing improvements in technology. A reverse situation, from a weather standpoint, could change the outlook materially. Wise action along the lines indicated above could facilitate correction of some of the distortions of the production pattern, particularly those in wheat and cotton. The technological revolution has attained a good deal of momentum. Whether its long-run effects be regarded as good or bad, we should for now shut off the driving power supplied by incentive prices and should seek to regain a more logical balance between output and market outlets. If some type of direct payment program that will not stimulate production can be devised, it might well be considered as a means of easing the impact of the harsh adjustments that must be made. It should not be permanent. If it is, it will prolong and perhaps prevent the adjustments which should be the basic goal of the program.

REFLECTIONS ON FARM POLICY, PAST AND FUTURE

G. E. BRANDOW
The Pennsylvania State University

I

THE following nine points were developed by looking back at recent experience and asking questions pertinent to farm policy for the future.

(1) The underlying problem confronting commercial farmers—as distinguished from subsistence or part-time farmers—emerged clearly as soon as the Korean inflation subsided. Agriculture came out of the war period with an excessive level of output relative to peacetime needs. Stimulated by rapid technological advance and unchecked by built-in restraints characterizing oligopolistic industries, farm production at comparable prices[1] rises more rapidly than market outlets expand. The imbalance between production and markets tends to be generalized over most of agriculture because of substitution among commodities in production and consumption.

(2) Labor requirements in agriculture have declined substantially, and cropland requirements have fallen in less degree. The size of unit needed for an efficient family farm has risen sharply. Both efficient use of national resources and achieving a satisfactory income situation in agriculture require that adjustments to these situations be made. But contraction of the labor force and cropland through natural market processes cannot

[1] Prices equating returns on labor and capital employed on efficient farms with returns in industry, non-monetary factors considered.

keep farm production in close alignment with market outlets at comparable prices when technology is advancing at recent rates.

(3) Acreage controls—allotments and so-called marketing quotas—have been only about 50 per cent effective on the controlled crops and have diverted land to other crops. These measures have been wholly futile in checking the expansion of total production.

(4) Many farmers are willing to put whole farms in the conservation reserve. Apparently effects on total output will be minor until the cropland involved gets in the 40-50 million acre range. Programs to "buy" retirement of a little land on many good farms (e.g., the acreage reserve) are too costly to be the mainstay of farm policy.

(5) P. L. 480 has initiated an important new idea, the use of food in assisting and developing underdeveloped countries. Further evolution of the idea can be expected. But in this broad area, foreign policy is the dog and farm policy the tail. It is not likely that an enlarged and well-balanced foreign aid program would call for sufficient exports of farm products to utilize all land and labor now in agriculture.

(6) Price supports have helped directly to sustain incomes of producers of supported commodities and indirectly to assist incomes from some other commodities, especially hogs. Probably net U. S. farm income would have been at least one-fourth lower without supports in recent years.

(7) The strong propensity for output to expand has provided ample protection for consumers' interests. Rising marketing margins have kept low farm prices from being fully reflected in retail prices, but agriculture has not been responsible for this.

(8) Farm programs have had surprisingly little effect on total resources used in agriculture, total output, size of farm or efficiency of production. The farm labor force has declined 27 per cent and crop acreage per farm has increased 23 per cent in the past 10 years. Probably the changes would not have been much different in free markets. Less machinery, equipment and fertilizer would have been used without programs, but the harvested acreage of crops in 1958 probably would have been higher. Gains in technology, size of farm and output per man-hour suggest that the efficiency of agriculture, in a physical sense, has been little affected by programs.

(9) Accumulation of excessive stocks and high Treasury costs are the undoing of present farm programs. Nonfarm people have become highly impatient with farmers, and many have conveniently convinced themselves that there is no farm problem. Current programs are the latest but not the last word in farm policy.

II

The economist trying to be constructive in the making of farm policy for the 1960's can propose programs that will give farm income some pro-

tection from the persistent tendency of production to outrun market outlets. There is no unique, best way to do this. Compensatory payments on base amounts of production and limited to volumes typically produced on 2- or 3-man farms are one alternative. The high Treasury cost of even a modest program will limit the income goals set for this approach. The method would be an effective means of assuring that vertical integration, where it develops, takes the form of contracts between farmers and business firms rather than ownership by the nonfarm party.

Real production control is potentially an effective means of supporting income from most commodities. The most comprehensive set of programs that seems possible in the near future has the following features: (a) negotiable quotas on marketing of wheat, cotton, tobacco and some other crops; (b) a compulsory acreage reserve at nominal rates to block shifts of land from these crops to others; (c) hog quotas combined with required nonuse of some feed grain acreage; (d) a high price for wheat for domestic food (but a similar procedure for cotton might greatly reduce domestic sales in a few years); (e) an enlarged conservation reserve for whole farms, and (f) a supplementary storage program for stabilization purposes. As the cotton-wheat comparison suggests, price objectives should be established with regard for market possibilities rather than by blind adherence to the parity formula. Whatever price and income policies are adopted, other programs should also be developed to prepare rural youth for nonfarm occupations and otherwise to expedite necessary long-run adjustments.

III

The economist merely attempting to forecast, however, may seriously doubt that the faults besetting the making of farm policy in the past decade will be much less prominent in the next. The problems agriculture confronts are largely economic, but the main difficulties of dealing with them are political, in the broad sense of the term. Regional and commodity differences within agriculture, rivalries of farm organizations, opposing interests of producers and consumers, partisan politics, and other divisive influences work against general agreement on appropriate objectives for farm policy and quickly erode programs capable of achieving attainable goals. Powerful groups refuse to believe that economic change forces basic adjustments upon agriculture. Others refuse to believe that agriculture can be more than temporarily out of equilibrium and will not quickly right itself in a free market. It is not easy to dispel illusions that the farm problem will be solved by such painless methods as finding new industrial uses, promotion and advertising, or getting rid of Benson.

A reasonable forecast, therefore, is that programs will continue to concentrate upon supporting farm income in the even numbered years but will not employ effective long-run means. Surplus stocks and program

costs will be so high most of the time that public dissatisfaction will force irregular retreat from program objectives. Eventually the price support programs for cotton, feed grains, dairy products and perhaps wheat will become nearly storage-for-stabilization operations, with only modest price-raising effects remaining. Rigid production controls will be applied to tobacco and a few other commodities but not extended generally. Meanwhile, many farmers will be more attracted by actions involving small groups with which they feel identified than by national farm programs. Marketing agreements and orders, cooperative marketing, promotion of regionally or varietally differentiated commodities, and collective bargaining with integrators are examples.

This is a pessimistic outlook for farm income. It need not be a correct one, but the environment within which farm policy is made must be greatly improved if purposeful action is to change it.

UNITED STATES FARM POLICY: AN APPRAISAL

Dale E. Hathaway*
Michigan State University

"Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually the slaves of some defunct economist."—J. M. Keynes, *The General Theory of Employment, Interest and Money*, p. 383.

Where indeed, is the economist who wishes credit for our present agricultural policy? In view of the steadily increasing dissatisfaction with this policy, it is not likely there will be many claimants for this honor. Yet, professional economists cannot escape some responsibility for the course our policy has taken since World War II, nor will an honest evaluation made at the end of the next decade be able to avoid the conclusion that economists have been responsible in part for the paths our policy has followed. Thus, since we are likely to bear part of the responsibility for the policies ahead, it behooves us to assess periodically the route recently traveled and the terrain immediately ahead.

Looking back it would appear that several conclusions may be reached regarding the performance of our national price and income policy for agriculture in recent years. They are:

(1) The program probably has maintained farm income (both in the aggregate and per capita) at levels higher than would have existed in the absence of a program.

(2) The program that has operated has not seriously impeded agri-

* The author received helpful comments from G. L. Johnson, L. W. Witt, J. T. Bonnen, and L. L. Boger.

cultural adjustment, especially the adjustment of the agricultural labor force.

(3) Aggregate agricultural "efficiency" probably has not been impaired by the program.

(4) The program of export dumping has been less disruptive than anticipated.

(5) Despite the conclusion that our recent program has not been a major contribution to the present difficulties in agriculture, neither has it contributed positively to a solution of the problem. Moreover, the recent programs may have contributed to other potential problems of considerable magnitude which will appear in the not too distant future.

Since at least the first four conclusions may run counter to those of many, a brief discussion of the reasoning underlying the above conclusions seems necessary.

The Income Effects of Recent Programs

In appraising the effects of the program upon farm income over the past five years, two questions appear pertinent: (1) given the level of output, did the program maintain prices above what they would have been in its absence, and (2) did the program cause the aggregate supply curve of agricultural products to shift to the right to the extent that farmers are producing greater output for less gross income than they would otherwise have received? The answer to the first question must be affirmative. The rate of accumulation of stocks by CCC despite expensive disposal operations should dispel all doubts on this point.[1] Since there is little evidence to suggest that the support program is *primarily* responsible for the recent shifts of the aggregate supply curve, the answer to the second is probably negative.[2] Another way in which the income of farmers could have been higher in the absence of a program is to assume that farmers are producing at a point where marginal costs exceed marginal revenue, which seems highly unlikely. Thus, it is probable that farm prices and incomes would have been much lower during the past five years had there been no price support program.

---

[1] See the article by Walter Wilcox in this *Journal,* August 1958, for estimates of the income effects of this stock removal.

[2] It is possible that the reduction of price uncertainty has caused farmers to reallocate resources so that a greater output has been produced at a lower price. Such possibilities are suggested by D. Gale Johnson in his book *Forward Prices,* The University of Chicago Press: 1947. This, of course, is desirable if efficient resource allocation is a goal. It is difficult to judge how much the reduction of uncertainty has contributed to recent increases in output, but in the absence of any support program prices would probably have been much lower and output only slightly lower. For a precise answer we need to know (a) How much, if any, has uncertainty been reduced by the programs, and (b) How much of the shift of the aggregate supply curve can be attributed to it?

The Effects of the Program on Adjustment

The program of the past five years cannot be charged with having prevented a major adjustment needed in agriculture—the movement of many underemployed farm families from farm to nonfarm employment. During recent years outmigration from agriculture, consolidation of farms, and movement of farm people to nonfarm occupations has gone on at an unprecedented pace. It has been a pace which has taxed the social structure of both urban and rural communities, and positive measures would have been necessary to have increased the rate above recent levels. The adoption of such measures would have required a considerable reshuffling of our national value systems.

There is little evidence that the support programs of recent years have caused people to stay in agriculture who otherwise would have left. In fact, the acreage allotments may have encouraged out-movement from some areas.[3] In addition, to the extent that farm land values were maintained by the programs, mobility may have been increased by making it possible for people to leave agriculture without taking serious capital losses.

The Effects upon Efficiency

In the sense that the aggregate "efficiency" of the agricultural industry can be measured by conventional inputs, agricultural efficiency has increased at a rapid pace in recent years, apparently exceeding the productivity gains in the nonfarm economy.[4] It is conceivable that these gains would have been faster in the absence of a program. If such had been the case, however, the price, income, and adjustment problems of agriculture would have been greater than those experienced.

It might be argued that the programs have led to a malallocation of resources within agriculture—the production of too much grains and cotton and too few animal products. Yet producers of vegetables, meat animals, and other products complain that the current programs are causing producers to switch from the production of the controlled crops to these unprotected commodities. Unfortunately, agricultural economists have done a great deal to perpetuate the myth that the *only* farm problem was the devotion of too many resources to the production of a few crops, implying that if these resources were switched to the production of things people wanted more of, everything would be fine.[5]

---

[3] *The Effects of Acreage-allotment Programs,* ARS 43-47, United States Department of Agriculture, December 1957, p. 43, states that cotton allotments were a major factor in outmigration of tenant and cropper families in sample areas.

[4] See the estimates by John W. Kendrick in "Productivity Trends in Agriculture and Industry," *Journal of Farm Economics,* December, 1958.

[5] See Chapter 12 of *Can We Solve the Farm Problem?* by Murray R. Benedict, (Twentieth Century Fund, 1956) as an example. The statement by Secretary of Agri-

The International Effects of Our Disposal Programs

Many thoughtful people were seriously concerned when the United States began its surplus disposal program under P. L. 480. It was believed that such a program would disrupt world trade in farm products completely, with serious effects upon both recipients and competing exporting countries. Although problems have arisen, to date these extreme fears have not been realized, and recent discussion has turned to the possibility of the semi-permanent use of our agricultural surpluses in a long-term program of economic development.

But Our Problems Are Not Solved

Despite the fact that our farm program of recent years has not been responsible for many of the problems attributed to it by government officials, farm leaders, and economists, it has been a failure in one respect. *It has failed, despite massive expenditures, to bring a solution to the United States farm problem.* The program has bought time, and this might have been a worthy expenditure if the problem had merely been one of a temporary collapse in demand, as was the problem of 1920-21 and the early 1930's. However, the recent problem is one of fundamental structural maladjustment which results in returns to labor in commercial agriculture significantly below those to comparable labor in the nonfarm economy. The failure to move toward a solution when it first occurred may appear in retrospect to have been a serious error, for there are reasons to believe the necessary adjustments may be more difficult in the period ahead than during the immediate past.

The Problems Ahead

Some, but not enough, attention has been given to the impending price problem in meat animals. Except for 1955, our agricultural surpluses have been largely confined to crops and dairy products and the low earning of labor in agriculture have been partially masked by satisfactory earnings of other resources in agriculture and substantial capital gains. As a result of increased output of feed grains (encouraged by support and control programs on other crops), favorable feed-prices ratios for livestock, and excellent pasture conditions in the range area, we have been increasing meat animal numbers.Within this year the increase will begin to reach our markets, and it is probable that within two years the income of producers of meat animals will be below the level that is politically acceptable. Actions of the Congress relating to feed grains during the last session will only intensify the problem, and any movement of wheat into

culture Benson in the February *U. S. News and World Report,* February 6, 1959, also carries this implication.

feed channels will make it worse. Thus, we are likely to enter the 1960's with even greater price and surplus problems in agriculture than we have experienced in recent years, making it difficult to maintain farm income at even the levels of recent years.

If these gloomy prospects materialize, over the next few years the income pressures for farm people to leave agriculture probably will be even greater than those of recent years. Here, however, the agricultural problem runs into a situation not experienced in the period of falling farm incomes of the 1950's. During the decade 1948-57, the labor force in the United States increased slightly more than nine million persons and nonagricultural employment by something over 7.5 million persons.[6] This occurred in spite of the fact that the number of persons reaching age 18 was lower in the postwar decade than in the 1930's and early 1940's and was slightly lower in 1956 than 1946.[7] Under such conditions it has been relatively easy for large numbers of farm people to find nonfarm employment, mitigating the downward pressures upon per capita incomes brought by declining gross farm income.

Even a causal examination of the statistics suggests the easy adjustments are over. A sharp rise in the number of persons annually reaching 18 years of age is upon us already and it will contine to increase with little interruption through 1965.[8] Speaking of the period 1960-65 the Bureau of the Census says, "But in the following 5-year period the influx of over half a million young workers a year (aged 14 to 24 years) will tax training, placement, and managerial skills.[9]

Thus, the magnitude of the farm problem facing us in the near future is likely to be intensified. On the one hand downward pressures upon farm prices and incomes appear likely to increase rather than diminish, and the declines will invade that portion of the farm economy which has, by and large, fared best in recent years. At the same time, the nation will be faced with absorbing record numbers of new nonfarm entrants to the labor force without substantial unemployment. This high rate of entry of new workers to the labor force will intensify the problems of less well-trained persons in agriculture who might desire nonfarm employment. Thus, one has to be highly optimistic to believe that the next five years will offer simpler and easier solutions to the adjustment problems of farm people than have the past five years. This is why the purchase of time by the present program may in retrospect appear unwise.

---

[6] *Economic Report of the President,* January, 1959, Table D-17, p. 158.

[7] *Economic Report of the President,* January, 1957, p. 95.

[8] *Ibid.,* p. 89, Chart C-2.

[9] Current Population Reports, "Projections of the Labor Force in the United States, 1955-1975," Series P-50, No. 69, October 1956, p. 8.

The Farm Programs Ahead

The probability of being wrong is very high when one attempts to predict economic trends for a decade ahead, and this probability rises sharply as one attempts to predict political events. However, some forces appear prevalent upon the political scene. First, in light of the many high-priority items that need national support, we probably have approached the maximum expenditure which can be expected from the nation to aid the agricultural industry. Second, future expenditures are more likely to be handled in a way which contributes less to price inflation and allows consumers to benefit from high output. This is likely to mean more government aid directly to farmers. Third, as soon as they realize the pervasive nature of the problem, the nonfarm economy is likely to insist that the farm programs move toward a permanent solution to the problem rather than a holding-action type program of recent years.

It will require the energetic attention of agriculture economists over the coming decade to provide accurate analysis of changing conditions, realistic appraisals of possible alternatives, and informed suggestions of the goals our policies should seek. The past decade has not been one of glorious achievement on our part. It is hoped the next will be better.

FEDERAL AGRICULTURAL PRICE AND INCOME POLICY, 1955-59

R. J. PENN
University of Wisconsin

SECRETARY Benson, in his 1956 annual report, and after the "flexible" price support level idea and the soil bank had been passed by Congress, had this to say about the kind of programs available to meet the agricultural price and income problems:

> Agriculture is now in a position to start its upward climb toward a more adequate share of the Nation's record prosperity.
> Surpluses are declining and the storage problem has passed its peak.
> Total and per capita consumptions of food are increasing.
> Consumers' income is at an alltime high and we expect it to set another new record in 1957. This means strong demand for food and fiber.
> The quantity of our farm exports in fiscal 1956 was at the highest level in 30 years.
> In the surplus disposal program, flexible price supports, and the Soil Bank, we have most of the basic tools we need to help agriculture in its present emergency.

But by February 10, 1959, before the House Committee on Agriculture, he had this to say about our present price support program:

. . . the present price support and acreage allotment programs, based on the results of over 20 years experience, have obviously failed. . . .

The law has required that the prices of 12 farm commodities out of the some 250 produced in the U. S. be supported at not less than certain minimum levels. This mandatory requirement, accompanied by complex but ineffective acreage controls and marketing quotas on the legislatively designated basic crops, has been the basic factor in our farm surplus problems. In general, producers of cattle, hogs, poultry, fruits, vegetables and various other products which are not price supported have experienced growing markets. They have not experienced a build-up of stocks in warehouses, expensive to the government to store and expensive to producers in the downward pressure on markets.

One criticism can be made of both of these statements: as so many of us have been doing in the last few years, the Secretary has oversimplified a very complex and difficult problem. Along with some others he has argued that virtually all that is necessary to solve the farm problem is to reduce farm product prices. Other agricultural leaders have made comments that suggest we could have a comprehensive farm program just by raising farm prices. Some economists have agreed that support levels at equilibrium prices will bring us out of the economic wilderness.

I have found myself saying that what we really need is to expand our livestock production and revise our feed grain and other so-called basic crop programs. But when one of my friends in the livestock business recently asked what kind of a price program I thought we should have for hogs in 1959 and for cattle in 1960, I found that my simplified statements were not of much value in constructing a workable program.

For my part in the symposium I should like to suggest some of the consequences that result when we treat the extremely complex price and income problem in agriculture as if it were a simple problem of level of price supports or of acreage allotments and quotas.

To oversimplify the problem may keep us from seeing or using facts necessary to formulate a workable program. If the problem is thought of simply as the result of too high price supports, it can be resolved by lowering them. Rapidly changing technology, supply response, price and income elasticities, changes in production structure, as well as market structure, are only a few of the areas which will be slighted if farmers, farm leaders, politicians, and economists fight only the battle of high vs. low supports. Dropping dairy price supports in 1954 did not decrease dairy production nor did it increase consumption of dairy products much. Many factors other than price were affecting dairy producers and consumers. But if the original simplified premise were to be rigidly held, it would suggest that failure to solve the problem could only have been due to unworthy human motives or incompetence on the part of the persons involved.

By placing major emphasis on the level of price supports, our programs tend to force each farmer to lower unit costs by increasing volume. The individual farmer has no alternative but to increase volume, in the short-run at least. This, of course, may be a gain for the whole economy in that the cost of agricultural products is reduced. But it continues to put downward pressure on farm prices, and the farm income position of agriculture relative to other parts of the economy has worsened.

Even more important, however, is the fact that emphasis on level of prices as the basis of the problem has kept us from adequately considering the major problems arising in the structure of our agricultural economy. Changes in technology have disrupted our production, marketing, and pricing structure. The individual farmer has been led to believe that all new technology must lead to bigness, and he knows technology will continue to change. So the farmer is concerned in a major way about developments in contract farming, integration, and specification buying. Too often economists have agreed that the only solution for agriculture is the very large integrated firm. Willard Mueller indicates that certain technological changes do not always require larger production units. A much more important reason for the existence of the large integrated firm is the failure of market prices to do the job of integration. I believe that government has a responsibility, which it is not fully exercising because our attention is diverted to the price support controversy, to see that large integrated firms do not expand beyond the point where they are economically justified. Maintaining a prosperous farm community is important. Financially poor farmers are most susceptible to poor integration deals. We should do everything we can to make the price system function better. Active encouragement of cooperatives may give the farmer more satisfactory marketing outlets. Farmers with adequate credit will not be dependent on an integrator to supply their credit needs. Farmers who keep abreast of technological change and changes in market demand are less likely to need integration. All these are areas to which government programs might contribute more than they are now contributing.

Simplified treatment of the farm price problem has resulted in considerable ill will among nonfarm people at a time when it is increasingly important for farm and nonfarm people to work out local problems together.

Urban people hear the simplified version of the farm problem. They ask why doesn't the farmer take a lower price since that is the solution to the problem. They are misled about what a lower farm price can mean to food prices to the consumers. They are constantly reminded of the "subsidies" received by farmers (and right at the present many are rather loosely using total loans and CCC holdings as the total of these "subsidies.")

When the soil bank was proposed as a solution to the price problem it was well received by urban people. I have heard many say, "Let's really make this program big enough to solve the farm price problem." Why then, the urban person asks, didn't more farmers put their corn land in the soil bank when the 1958 average payment per corn acre in Wisconsin was about $54? Why, too, does the surplus problem still exist after three years of the soil bank program with heavy government cost?

Discussions of this nature have generated altogether too much ill will between farmer and nonfarmer. This has come at a particularly bad time, since the rapid urban expansion into rural areas is bringing a vast new set of local problems. Problems for farmers arise from the "loss of farm land" to nonfarm uses such as land for highways, recreational areas, industrial sites, and space for urban homes. However, much more important are the issues relating to planning, building, financing, and operation of municipal services—services such as water supply, sewer, fire and police protection and particularly education.

To resolve this kind of issue requires action by farmers and nonfarmers working closely together under the most trying situation. For instance, in the case of a newly developed subdivision in a rural town it is easy to see how friction can develop between the farm people and the newcomers over just one service, the school. The newcomer buys his house and moves in only to find there is no school for his children. The children should have a school and the school district officers have some responsibility for providing it. However, the school board generally must get its revenue from property taxes and state shared taxes. Taxes from the new homeowner do not become available to the school board until nearly two years after he has moved in. And, if adequate school planning is done, it must begin nearly two years before the school is needed. Farmers are members of the school board.

It is hard to construct a more explosive situation. Its solution requires the best statesmanship of both urban and rural people. And this is only one type of intense and rapidly increasing local problem which requires rural-urban understanding. Possibilities of solution have not been enhanced by increasing ill will growing out of the federal price and income program.

I mark this as only one—but by no means the least important—result of the refusal of some agricultural leaders to recognize that the farm problem is not susceptible to simple "formula" solutions. I am concerned that, in terms of more difficult relations between farmers and nonfarm people, we may reap the harvest for a long time to come.

AGRICULTURAL POLICY FOR WHAT?

THEODORE W. SCHULTZ
University of Chicago

YOUR editor wisely hedged the risk he took in asking for this statement by making sure that it be brief and that it be an appraisal of something we do not have, i.e., *An Agricultural Economic Policy.*[1] Alice timidly turned to the wide-grinning Cheshire Cat, "Would you tell me, please, which way I ought to go from here?" "That depends a good deal on where you want to go to," said the Cat.

I want to focus attention on two core problems facing U.S. agriculture, to examine particular policy implications of these problems, and then to indicate a positive and consistent approach to these two difficulties that beset agriculture. Said the Cat to Alice, "Now we are getting somewhere; in that direction lives a Hatter and in that a March Hare and they're both mad."

Two Core Problems

One of these[2] is represented by the fact that the U.S. government has been acquiring from 6 to 8 per cent of the annual production of agriculture. This one is quite *visible*: large stocks of commodities, large appropriations to administer the price supports and to dispose of the "surplus" that the government acquires. It is this problem that looms so large in public policy debate. Two points are as a rule overlooked. These stocks and the expenditures they entail have not been the result of particular estimates of production and prices that went wrong either because of a falling off of demand, or because of a run of good weather, or because of some other unforeseen change that affected adversely the prices of farm products; they have been unmistakably a consequence of actions taken by the U.S. government with knowledge that it was establishing farm price supports that were high relative to market values. The other point is that neither the present level of farm price supports, nor higher price supports, would contribute to the solution of the second farm problem, much the more important of the two, to which I now turn.

The other core problem is represented by the fact that the value productivity of much of the human effort devoted to farming is far below par

[1] See D. Gale Johnson's paper, "Agricultural Economic Policy of the United States," presented at the meeting of the American Association for the Advancement of Science (AAAS), Washington, D.C., December, 1958.

[2] I shall not consider a third problem represented by the instability of farm prices and income because it has been less acute in recent years than formerly.

for comparable human effort in the rest of the economy. This problem is quite *invisible*. It is hidden because in farming it is hard to identify and measure these earnings, because the relevant factor markets are hard to get at, and because of the heterogeneity and the dynamic elements that characterize agricultural production. Some of these low earnings are of long standing. There is the chronic poverty of most of the farm families, mostly white, in upwards of 500 counties in the United States; and the forgotten plight of negroes in agriculture, 2,800,000 of them. The problem of low earnings is made especially acute for those farm people who "sell" their labor in competition with the 400,000 or more foreign nationals who presently enter the United States and serve as farm workers. Added to these, there is the greatly weakened economic position of farm labor generally, both hired and self-employed, throughout commercial agriculture that is a consequence of our kind of economic growth.

To cope with these two farm problems a radically different approach is imperative. Presently we are engaged in holding the prices of some farm products above market values and, then, *waiting* for the low earnings to freeze enough farm people out of farming to restore an economic balance. A more traditional approach would be to lower the farm price supports so markets clear and then do as we are doing now, *wait* for the low earnings to force the adjustments unaided. Events and logic, however, argue for a positive economic policy to assist people make the adjustments that are required to increase their earnings relative to other workers with the further objective that these adjustments be brought about more rapidly and at less social cost than is now the case. Along with such a policy, price supports should be gotten into line with market values.

In clear and simple language the earnings of many persons in the farm labor force, both hired and self-employed, are too low and the price supports of some farm commodities are too high; the basic policy objective, therefore, should be to bring the relevant earnings up and the particular price supports down.

Policy Implications

But if earnings are too low why not do something to bring the market value of farm products up to match the high price supports? One proposal for doing precisely this consists of "comprehensive" supply controls. Past experiences with farm production controls, except for minor things, notably tobacco, indicate that it is most difficult politically to enforce such controls. Suppose, however, the controls were attained, the outcome would probably be as follows: (1) The owners of the land that is used for farming would soon capture most of the additional revenue, (2) the price and in-

come consequences would be *regressive* in their effects on the personal distribution of income among farm families, and (3) a defensible result, it would "buy" some additional time for more millions of farm people to find non-farm jobs and move to them.

No one will contend that owners of farm land are in distress. On the contrary, farm real estate prices have been booming. This boom could burst but it continues presently. Last year alone, for example, it added virtually 7 billion dollars to the value of U.S. farm real estate, a tidy amount of capital appreciation for those who own this land. Two fifths of it is owned by non-farm individuals and families. By some strange twist, that is inexplicable, many an agricultural economist and political "leader" recommends public action that would favor the owners of farm land above all else. Virtually none would appear to favor measures that would directly enhance the earnings of farm people that comes to them for the work they do in farming.

No one is prepared to argue openly, so I suspect, that the United States should have farm programs that are regressive in their effects on the personal distribution of income among farm families. Few if any would hold this to be a desirable policy goal. Unwittingly, then, intellectual and moral support is given to this goal by a failure to examine the net income effects of the present farm programs which for a long time have been and continue to be substantially regressive. Sight is lost of the fact that the poor in farming are virtually by-passed and the well-to-do reap a disproportionately large share of the additional revenue from public subsidies and high price supports. Nor do those who endorse a program of "comprehensive" supply controls make explicit the regressive income effects of such controls were they to be enacted and enforced.

Farm people do need time to adjust to the revolution in agricultural production that is on us. An unbelievably large number of them have been leaving, so many in fact that the net migration from farms averaged over one million a year between April, 1947 and April, 1957. Off farm jobs are indispensable; to wit during each of two years 1952 and 1956, when employment opportunities in the nonfarm sectors were good, the net migration from farms was two million or more (no less than 10 per cent of the farm population in 1956) and then in two other years, 1954 and 1957, when jobs were hard to find because of much unemployment in industry, it was virtually zero.[3]

But time and good job opportunities on the nonfarm sectors, although

---

[3] See Table D-65, *Economic Report of the President,* January, 1959. In 1954 the U.S. farm population was off by only 91,000 and in 1957 it appeared to have gone up by 93,000. Each of these changes is for the year beginning April 1.

essential, are not enough. In addition, and exceedingly important, is some public assistance for many farm people who presently want to and who ought to leave farming. They want to leave because of the very low earnings that are freezing them out of farming; they ought to leave because it is necessary to correct the great disequilibrium within agriculture caused by the kind of economic growth that we have been experiencing.

But no such public assistance has been forthcoming. It is in this area that public policy has failed to act. Things that cry out for public action include: a revamping of the Federal Employment Service so that it is not prohibited from recruiting but instead is authorized to recruit for nonfarm jobs among farm people; vocational training for agriculture and 4-H boys and girls club work needs to be reoriented; and, new nonfarm housing and schools and other community facilities are required for farm people who want to take jobs in such communities. Homesteads in Reverse[4] is an important way of rendering public assistance in this area.

A Policy Tableau

1. *To bring earnings up* we should provide public assistance that will reduce substantially the *adjustment lag* that presently characterizes the mobility and out-movement of farm people. Such public programs should be assessed in a framework of social returns and costs and the funds so used should be viewed as a form of *adjustment capital.* A high rate of social returns is likely to be realized on a substantial amount of such capital. The basic justification for doing these things arises out of the fact that the revolution in agricultural production, making it necessary for millions of people to leave our farms, stems in large part out of the expenditure of public funds for agricultural research and extension work.

2. All public programs that are presently increasing agricultural production, except one, should be put into abeyance; for example, federally supported irrigation projects and the agricultural conservation programs which support liming, the applications of superphosphates and potash, pasture improvements, drainage, erosion control, land leveling, and more irrigation. The exception relates to those public funds allocated to agricultural research and extension work because the social rates of return on these funds appear to be very high, albeit much of great disequilibrium that characterizes agriculture has its origin out of the production results that have been attained in the use of these funds.

3. Foreign nationals who enter the United States to do work should only enter the nonfarm labor force; they should not enter the U.S. farm

[4] See my "Homesteads in Reverse," *Farm Policy Forum,* Vol. 8, No. 5, Iowa State College, 1956.

labor force because of the low earnings that prevail in the farm sector and because of the nature of the disequilibrium that lies back of these low earnings for human effort in farming. (This proposal should not be construed as an argument against foreign nationals entering.)

4. A transition schedule should be established to bring farm price supports down and into line with market values; they should be used as a system of forward prices set somewhat below the true expected equilibrium price. Income payments could play a useful role in making such a transition. Existing government stocks should be isolated and disposed of in ways that will not affect adversely the relevant market values.

Alice may have been right all along. As between a Hatter and a March Hare, a March Hare is the more interesting of the two, especially in May for then "it won't be raving mad."

FOUR ECONOMISTS IN THE POLITICAL PROCESS

Richard S. Kirkendall
University of Missouri

HOW can the agricultural economists help to shape the nation's farm policy? Perhaps a historical analysis of the experiences of the economists of an earlier day who had some influence upon national policy may hold something of significance for the policy-oriented economists of today.[1]

Many economists contributed to the development of New Deal farm policy. This paper will look at but four of the most prominent who were both professors and economists: Rexford G. Tugwell, M. L. Wilson, George F. Warren and William I. Myers. Their role was large—too large to survey in these pages. But the basic significance of their experiences can be discussed.

That significance lay in the relationships between ideas and power. When these economists became interested in shaping policy, they found that they had entered a world in which power was the fundamental reality. They found that they had to think in power terms as well as economic terms. Economists had to explore the location, function, and nature of power and the ways in which changes in elements in the political situation influenced power relationships. The economists' ideas helped them to gain access to power for men of power needed economic ideas. But the ideas alone, no matter what their quality may have been, did not enable the economists to control policy. They first had to establish working relationships with men who had the capacity to control policy. Thus the ideas of the economists had to appear to harmonize with the interests of such men. In short, Tugwell, Wilson, Warren and Myers found, often from bitter experience, that men of ideas needed to learn to work with men of power. Economists needed to learn to work with officeholders, representatives of organized interest groups, men of wealth, and men with political skills.

The pragmatic orientation of much of the American academic world provided an underlying explanation of the ability of these economists to work with some men of power. By the 1930's, as one well-informed observer of the "Brain Trust" noted, American universities had for "nearly forty years" been insisting that their "business" was "not only to preserve, to increase and to interpret knowledge, but to carry scholarship and

[1] For a more extended study of those experiences see R. S. Kirkendall, "The New Deal Professors and the Politics of Agriculture," unpublished Ph.D. thesis, University of Wisconsin, 1958. The following footnotes will attempt merely to indicate some of the more important sources of the study.

scientific knowledge into the four corners of the earth for the service of mankind and the solution of its problems."[2] "Service" is the key word here. Agricultural economists, and other men like them, should be called "service intellectuals." "More than any other group of economists," a distinguished journalist has maintained, "American agricultural economists have a habit of leaving their ivory towers. . . ."[3]

The four professors believed in and carried out the role of the service intellectual. "Never has the world been more obviously in need of expert leadership and never has the obligation more obviously devolved upon a single group," Tugwell argued before he came to Washington. "It is the clear duty of American economists to say what the economic system of America can do and should do and to point the true path toward new goals."[4] Though Wilson, Warren and Myers had somewhat more modest conceptions of the economist's role, they demonstrated their pragmatic commitments by their frequent associations with farmers, businessmen and politicians in order to deal with economic problems.

Economists, of course, could turn their attention to public affairs and devise solutions for pressing problems and yet have no impact upon the world outside of the academy. Men of power could ignore the professors, believing that they could contribute nothing of importance. It was not enough that many intellectuals by the 1930's had developed a service orientation. Other men had to recognize the development and turn to the economists for advice.

Some men who held governmental posts did believe in the service intellectual and thus gave these economists a chance to influence policy. President Roosevelt and Secretary Wallace deserve emphasis here. Roosevelt used such men in the same large way that Governor La Follette did in the early days of the progressive movement.[5] As governor of New York, F.D.R. developed such a "strong habit of depending upon specialists and academic men for technical advice" that, as Frank Freidel has written, "it was not only logical but almost inevitable that he should turn to them in 1932."[6]

Roosevelt not only used such men; he also defended his use of them. When critics cried out that academic men dominated his administration, he did not hesitate to admit that they were playing important roles. "While there has been a certain amount of comment about the use of

---

[2] Nicholas Murray Butler, *New York Times,* June 7, 1933.

[3] L. K. Soth, "Making Economics Understandable," *Journal of Farm Economics,* August, 1946, p. 852.

[4] *The Trend of Economics,* New York: Crofts, Inc., 1924, p. 384.

[5] B. Bellush, *Franklin D. Roosevelt as Governor of New York,* New York: Columbia University Press, 1955, p. 229.

[6] *Franklin D. Roosevelt; The Triumph,* Boston: Little Brown and Co., 1956, p. 101.

brains in the national government," he noted in a public speech, "it seems to me a pretty good practice—this practice of calling on trained people for the tasks that require trained people."[7]

Roosevelt's support or lack of support frequently determined the fate of the ideas of these four professors. For example, Wilson's production control plan did not get the support it needed from the farm leaders until they recognized, after F.D.R.'s Topeka speech on farm policy in September of 1932, that the candidate had an interest in the plan.[8] And in the spring of 1933, he still had to apply pressure upon Congress to overcome the opposition to the plan by groups such as the processors of farm products.[9]

If Roosevelt should be compared with La Follette, Wallace can only be compared with his father when looking for other top men in the Department of Agriculture who have worked closely with and offered support for economists.[10] Henry A. Wallace had a high regard for economists "who thought of agricultural economics as something which was not merely theoretical and academic, but something living, moving, active and directional in the world of affairs." Some economists, he insisted, "must rise beyond their interest in supply and demand curves and become concerned with the world of intangible values and with ultimate direction."[11]

The history of the Bureau of Agricultural Economics (BAE) from 1938 to 1946 provided a significant illustration of Wallace's importance to the economists. In 1938, the Secretary made this stronghold of the agricultural economists the central planning agency for the Department of Agriculture. Wilson and Tugwell shared with a number of economists a strong interest in the kind of planning that the new BAE was to promote. Wallace fought with Congress and Department of Agriculture agencies to get them to accept the new definition of the BAE's role, but Wallace's successor, Secretary Wickard, failed to defend the Bureau against the ultimately successful attacks of its enemies. Their success dramatized the importance of the economists' relations with men who occupied official positions of power. "It is possible," a well informed student of farm politics has concluded, "that if Wallace had remained Secretary of Agriculture and had

---

[7] *New York Times*, June 21, 1934.

[8] M. L. Wilson to Raymond Moley, September 28, 1932; Wilson to J. D. Black, October 7, 1932; Wilson to C. R. Hope, October 10, 1932; Wilson to J. S. Davis, October 26, 1932; W. R. Ronald to Verne Brady, November 7, 1932, Wilson Papers, Montana State College, Bozeman.

[9] R. G. Tugwell, *The Democratic Roosevelt; A Biography of Franklin D. Roosevelt*, New York: Doubleday Doran, 1957, p. 277.

[10] J. H. Shideler, *Farm Crises 1919-1923*, Berkeley: University of California Press, 1957, especially pp. 123-41.

[11] "Farm Economists and Agricultural Planning," *Journal of Farm Economics*, February, 1936, pp. 1, 11.

continued such support as he gave in 1939 and 1940, and the war had not intervened, the role assigned to the Bureau would have been increasingly realized over the next ten years."[12]

But why did a man of power like Roosevelt rely upon certain economists and not others? Many men in the profession who had strong devotion to practical affairs failed to get the backing of executive power. Obviously one has to look beyond the development of the service intellectual and Roosevelt's endorsement of that development to explain the relationships with power that these four economists established. Part of the fuller explanation lay in the accident of personal relations. Roosevelt's personal ties with Raymond Moley and Henry Morgenthau, Jr., helped Tugwell, Wilson, Warren and Myers.

Moley helped Tugwell and Wilson. The Columbia political scientist had become a Roosevelt adviser before the election year in which the "Brain Trust" was formed. When the candidate needed to shape a national farm policy, Moley looked not to a logical place—Cornell—for a New York governor to turn to for advice on farm matters. Rather, Moley called upon one of his own colleagues at Columbia who had been devoting some attention to farm matters.[13] Thus Tugwell entered the Roosevelt camp and was assigned the task of finding the best farm plan. His search led him by June of 1932 to Professor M. L. Wilson of Montana State College and the other men who were developing the voluntary domestic allotment plan for the control of farm production. Impressed with the political and economic possibilities of the plan, Tugwell in turn introduced Wilson to Roosevelt. The three professors—Moley, Tugwell and Wilson—worked to get the candidate to accept the plan.[14] Justly, then, Wilson later praised Moley—a professor who had devoted most of his career to urban problems—for the "very important part" that he had "in a very formative period of the new agricultural policies."[15]

[12] J. D. Black, "The Bureau of Agricultural Economics—the Years in Between," *Journal of Farm Economics,* November, 1947, p. 1033-36. Interviews with M. L. Wilson, Howard Tolley, Bushrod Allin, and F. F. Elliott, June 29, 1956 and with Henry A. Wallace, June 12, 1958. C. Hardin, "The Bureau of Agricultural Economics under Fire; A Study in Valuation Conflicts," *Journal of Farm Economics,* April, 1946, pp. 638, 643-45. Hardin, *Freedom in Agricultural Education,* Chicago: University of Chicago Press, 1955, pp. 161, 164.

[13] Moley, *After Seven Years,* New York: Harper and Brothers, 1939, pp. 15, 18-19.

[14] R. G. Tugwell, "Notes from a New Deal Diary," December 31, 1932, Roosevelt Library, Group 21. M. L. Wilson to Ralph Budd, July 22, 1932; Wilson to C. R. Hope, October 10, 1932; Wilson to Moley, August 22, 1932; Wilson to W. L. Stockton, September 15, 1932; Wilson to J. D. Black, October 7, 1932; Tugwell to Wilson, September 30, 1932; Moley to Wilson, September 4, 9, 1932, Wilson Papers. Moley, *op. cit.,* pp. 41ff. Interview with Wilson, June 27, 1956. Wilson to Herman Kahn, January 17, 1956; Roosevelt Library, Group 31.

[15] Wilson to Moley, May 20, 1939; National Archives, Records Group 16, Secretary's Correspondence (Under Secretary—Personal).

The relations between members of the same faculty assisted Tugwell and Wilson; the relations between student and teacher helped Warren and Myers. Morgenthau, while attending the college of agriculture at Cornell, had come to admire Professor Warren. Thus, when a friend of Morgenthau's became governor of New York and called upon the Cornell graduate and farm editor for advice on New York agriculture, Morgenthau brought his former teacher into the administration. As a result, Warren got a chance to bring his monetary ideas to Roosevelt's attention. Furthermore, during 1932 and '33, Morgenthau tried hard to convince his friend of the value of the professor's ideas.[16]

Warren's busy schedule gave Myers his chance. That schedule would not allow the monetary theorist to respond to Morganthau's call for an adviser on farm matters in the crucial months that followed the election of 1932. Morgenthau thus turned to one of Warren's colleagues, Professor Myers. The latter pushed his own ideas on the reform of the nation's agricultural credit institutions and policies, and Morgenthau brought the professor and his ideas to Roosevelt's attention. Those ideas soon developed into the Farm Credit Administration (FCA).[17]

Not all who held formal positions of power treated the professors as Roosevelt and Wallace did. Many congressmen, for example, fought the influence of the professors. After Myers became governor of the Farm Credit Administration, he frequently encountered powerful congressmen who disliked his ideas. Success often came to the congressmen during the 1930's in spite of presidential support for the economist. He and his Congressional opponents fought chiefly over the interest rate on government loans to farmers. The governor of the FCA believed that the "cheap credit" policies of the congressmen forced the government to provide the farmer with undesirable subsidies.

Of the four professors, Tugwell had the poorest relations with congressmen. Opposition to him came from Democrats as well as Republicans. Much of his trouble came from powerful southern senators such as "Cotton Ed" Smith of South Carolina and Harry Byrd of Virginia. To them, he seemed both impractical and radical. They fought his promotion to the post of Under Secretary. (Smith insisted that such a post should be filled by "one familiar with the lowly and despised occupation of farming instead of a professor" and that "the man who holds that job should be a

---

[16] Interview with Frank A. Pearson, June 14, 1956. A. S. Everest, *Morgenthau, The New Deal and Silver; A Story of Pressure Politics*, New York: King's Crown Press, 1950, pp. 27-28, 34-35. D. R. Fusfeld, *The Economic Thought of Franklin D. Roosevelt and the Origins of the New Deal*, New York: Columbia University Press, pp. 192-94.

[17] Interview with Myers, June 14, 1956. Tugwell, "Diary," January 12, 13, 21, 1933.

graduate of God's University, the great out-doors."[18]) Such men also fought the appropriations for his Resettlement Administration and even continued to lash out at him after he had left Washington.[19]

However, the relations between congressman and economist cannot be described in negative terms alone. Often congressmen supported the ideas of the economists. Even Tugwell had his supporters on the Hill, especially among many of the same men who opposed Myers. ". . . the attitude of at least 10 Senators is determined very largely by the presence in the Department of Dr. Tugwell," Wallace's secretary told a former associate. "The same can be said about a considerably larger number of Representatives."[20]

Wilson showed great skill when dealing with the legislators. No congressional fights took place when he succeeded Tugwell as Under Secretary. "I know of no appointment," Senator Murray wrote the President, ". . . that shows such a keen desire to place in key positions men of the very highest training, experience and merit than this appointment."[21] The Montana professor had established working relations with congress even earlier than with Roosevelt. Leaders from the farm belt—Congressman Hope of Kansas and Senator Norbeck of South Dakota—had introduced bills in 1932 that Wilson had helped to develop.[22] While serving in the Department of Agriculture, his careful attention to political realities in the farm areas enabled him to be of service to congressmen in their political campaigns. ". . . when you spoke in Salt Lake City, and in Logan," Senator Thomas of Utah informed Wilson after the 1938 election, "you turned the tide of sentiment toward us from every doubtful agriculturist and agricultural sympathizer within sound of your voice."[23]

A politician such as Senator Thomas, of course, hoped to maintain and expand his power. Thus he valued the ideas of the economists according to the ability of those ideas to serve the interests of his constituents. This points to the need to look beyond the relations between the economists and the officeholders to other factors that influenced those relations. To understand the experiences of the professors one must consider their relations with nongovernmental power groups and the ways in which

---

[18] *New York Times*, April 25, May 29, 1934.

[19] L. Hewes, *Boxcar in the Sand*, New York: Knopf, 1957, pp. 75, 82-83, 202-03. Tugwell, *Democratic Roosevelt*, pp. 443-44, 472-73. G. McConnell, *The Decline of Agrarian Democracy*, Berkeley: University of California Press, 1953, p. 105.

[20] Paul Appleby to W. W. Waymack, March 1, 1935, National Archives, Records Group 16, Secretary's Correspondence, Criticism-Commendations.

[21] January 13, 1937, Roosevelt Library, Official File 1.

[22] *Congressional Record*, 72 Congress, 1 session, vol. 75, part 14 (1932), pp. 15393-98, 15641-43. Wilson Papers, especially Hope folder.

[23] November 14, 1938, National Archives, Records Group 16, Secretary's Correspondence, Politics.

those relations were affected by developments in elements within the political situation. To influence policy—the experiences of the New Deal professors suggest the economist must attempt to persuade more than those upon whom law has conferred power. In fact, the demands of extralegal power groups often determined the relationships between the ideas of the economists and the actions of the officeholders.

Various developments affected power relations and hence molded the experiences of the four men. Political developments of the late 1920's for example, influenced significantly the relations in 1932 between Roosevelt and the farm groups and therefore the relations between him and the farm economists. On the one hand, he needed to work hard to get the support of the groups because Al Smith had hurt the Democrats in farm areas. (Professor Schlesinger has argued persuasively that the "essence of the Democratic problem was to bring these rural Democrats back into the party."[24]) On the other hand, Roosevelt had a good opportunity to obtain the farm vote because Republican vetoes of the McNary-Haugen plan had weakened that party in the Midwest. Such a situation made farm economists important to the politician but did even more to add to the power of the farm groups. Roosevelt, thus, turned first to the farm problem in 1932, and Tugwell became Moley's first recruit for the "Brain Trust." But the candidate proceeded cautiously and hesitated during the campaign to identify himself too clearly with the programs advanced by the economists for he did not want to antagonize any of the farm groups.

Price developments also affected power relations and the careers of the economists. The low prices at the bottom of the depression generated interest in inflationary schemes such as Warren advocated. Some business leaders, for example, took a strong interest in his commodity dollar idea. A statement by a group of these leaders—the Committee for the Nation—revealed how the price factor in the situation worked to bring powerful support to Warren:[25]

> The greatest evil that can befall us will be to pursue the program of liquidation to a point which develops such economic difficulties and arouses such social protest as to bring about a chaotic situation and then in the confusion of panic to attempt hurried remedies of inflation or devaluation which would bring upon us all the evils of both courses of procedure. It is a lively appreciation of what such a double calamity might mean that has led us to give consideration to currency changes which in the eyes of many business men and bankers would at first seem to be the acme of unsound projects.

[24] *The Age of Roosevelt; The Crisis of the Old Order, 1919-1933*, Boston: Houghton Mifflin, 1957, pp. 274-84, 289-92, 390. Freidel, *op. cit.*, pp. 8-9, 37, 41, 62-63, 76-79, 95-98, 165, 229, 240, 256, 268-71, 274-75, 285, 341-42, 351. G. A. Slichter, "Franklin D. Roosevelt and the Farm Problem," *Mississippi Valley Historical Review*, September, 1956, pp. 247, 255-58.

[25] A copy of this confidential report of February 26, 1933, is available in the George Warren Collection, Box 14, Cornell University Archives, Ithaca, New York.

The temporary price drop, especially in farm products, in the summer and fall of 1933 forced the final decision to embark upon Warren's gold buying scheme. The drop, which came after several months of rising prices, stimulated all of Warren's supporters and also the more thoroughgoing inflationists to step up their pressure upon congress and the administration. Businessmen expressed their fears that farmers might take radical action and advised that Roosevelt needed to restore farm purchasing power so that he would "be our greatest and not our last President."[26]

Roosevelt needed a dramatic program to raise prices and reduce discontent. His advisors who feared the domestic and international consequences of Warren's program had nothing dramatic to offer. Warren did. Thus price changes worked to reduce the power of his opponents and to add to the power that he and his supporters possessed. Roosevelt, as James Warburg has argued, most likely would not have undertaken the scheme "if there had been no widespread distress, no threat of disorder arising from this distress, and, above all, no articulate and vociferous demand for inflation. . . ."[27]

Depression and war as well as price developments affected the political careers of the economists. Some of their programs depended heavily upon the depression for political success and suffered major defeats when war replaced depression as the chief problem facing the nation. The fate of the programs for the rural poor illustrated the impact of depression and war.

Tugwell and Wilson had an interest in such programs and contributed to the development of agencies such as the Resettlement Administration and the Farm Security Administration (FSA). The depression forced the nation to concern itself with the newly recognized and expanded problem of rural poverty. Even the politicians who wanted to ignore the problem had to pay some attention to it in order to meet the challenge of men such as Huey Long who built up large followings by exploiting rural misery.

Elaborate though inadequately financed programs developed during the 1930's only to suffer sharp reductions during the war period. The war worked in many ways to wreck the programs. It reduced the dimensions of the problem by creating temporary job opportunites for FSA clients in defense plants and the armed forces. FSA personnel had their attention diverted to wartime activities, including the evacuation of Japanese-Americans from their homes on the Pacific Coast. Former supporters of the programs, such as President Roosevelt, had to concentrate their atten-

---

[26] F. E. Murphy to H. A. Wallace, October 12, 1933, Roosevelt Library, Official File 1. *cf.* F.D.R. to his mother, October 28, 1933; E. Roosevelt ed., *F.D.R.: His Personal Letters, 1928-1945,* New York: Duell, Sloan and Pearce, 1950, Volume 1, p.. 366.

[27] *The Money Muddle,* New York: Knopf, 1934, pp. 133, 141-48. *cf.* F.D.R. to William Woodin, September 30, 1933, Roosevelt Library, Official File 229.

tion upon the conduct of the war and had a new need for the support of opponents of the programs. Thus, because of what the war had done to their power, those opponents were able to reduce New Deal programs for underprivileged groups.[28]

Enough has been said to demonstrate the importance for the economists of the somewhat flexible character of power relations. Changes within the political situation clearly affected power relations and the experiences of the professors. This attention to the role of various changes and also the attention to the economists' relations with the officerholders have already suggested that one cannot understand the successes and failures of the four economists unless he considers the role of extralegal power groups. Their importance demands a closer look at the relations between the economists and such groups.

Franklin Roosevelt's conception of leadership assumed that pressure groups occupied very important positions in the American power structure. This conception influenced his relations with the economists and their relations with the groups. He believed that a leader in modern American politics had to work with such groups, gain the support of as many of them as possible, and develop programs that would keep them behind him. Thus, though he respected economists, his conception of political realities would not allow him to turn policy making over to them. He encouraged them to contribute, but at the same time he encouraged the representatives of the power groups to make contributions. Certain romantic conceptions—some hostile and some favorable to the New Deal—viewed that political movement as largely the creation of academic intellectuals. Such conceptions betrayed an ignorance of the American political process, especially as it was engaged in by a master politician. As one outstanding journalist noted in the 1930's, "this remains a political form of government and . . . Mr. Roosevelt is taking his objectives by political methods."[29] This meant that economists had a chance to be useful but not to dominate. Their relationships with the power groups often determined their utility from Roosevelt's point of view.

Three of the professors developed cooperative relationships with major interest groups. Myers did particularly well. Powerful groups such as the Farm Bureau, the Grange, the National Cooperative Council and the life insurance companies fought beside him against his opponents in congress and the Department of Agriculture. The battle extended over a consider-

[28] Hewes, *op. cit.*, pp. 55-58, 75, 80, 85, 155-58, 203-04, chaps.. 14-16. Tugwell, *Democratic Roosevelt*, pp. 423-25, 448. McConnell, *op. cit.* chaps. 9 and 10.

[29] H. Pringle, "Profiles; The President," *New Yorker*, June 16-30, 1934, p. 22. (*cf.* Kirkendall thesis, pp. 30-41) and J. M. Burns, *Roosevelt; The Lion and the Fox*, New York: Harcourt, Brace and Co, 1956.

able period of time. Eventually, however, Myers and his supporters achieved a credit system such as he desired.[30]

Myers shared many of the basic assumptions of these groups and sought to run the FCA accordingly. Thus, it is not difficult to understand why they backed a professor. He reorganized and consolidated the government's agricultural credit institutions with the hope of achieving greater efficiency in operation. He worked to establish the FCA as a "business organization" operating on a "business basis" and meeting the business needs of commercial farmers. He denied that his organization should attempt to meet the financial needs of all farmers.

These ideas rested upon a lack of confidence in the economic abilities of the government and a great deal of confidence in the leading private financial institutions. Therefore, Myers did not want the farmer to be dependent upon government credit. Rather, the Cornell professor sought to organize the farmer for credit purposes so that he could tap the private money market more effectively. "The purpose of the Farm Credit Administration," as this economist defined it,[31]

> is to put agriculture on a basis of credit equality with corporate industry by providing permanent business organizations through which large numbers of individual farmers whose credit basis is sound, but whose requirements are small, may have constant access to the investment markets.

Professors Warren and Wilson also worked impressively with major power groups. Long before 1933, Warren had carried his charts and his message on monetary matters to meetings of New York farmers and businessmen. By early 1933, as the publication of the Dairymen's League reported, farmers all over the country were "rallying to the support of this plan to stabilize prices by revaluing the dollar."[32] This New York dairy cooperative and especially the Farm Bureau laid down a vigorous propaganda barrage in order to get the public and the politicians to endorse Warren's plan.[33]

---

[30] Myers to the author, July 6, 1956, Roosevelt Library, Official File 27 and 27-Misc., especially John D. Miller to Roosevelt, May 12, 1938. J. F. McDermott to Roosevelt, December 15, 1934, Roosevelt Library, President's Personal File, 2132. Nils A. Olsen, *Journal of Farm Economics*, February, 1937, p. 92. Paul Bestor, *Journal of Farm Economics*, February, 1941, pp. 67-68.

[31] Important sources for his views are two of his writings in the *Journal of Farm Economics*, "The Program of the Farm Credit Administration," January, 1934, and "Important Issues in Future Farm Credit Administration Policy," February, 1937. Also valuable are his statements before the Conferences of the Presidents of the Federal Land Banks from 1934 to 1938. These are available in the National Archives, Records Group 103.

[32] *Dairymen's League News*, January 24, 1933.

[33] *Bureau Farmer*, January, 1933, p. 9; December, 1933, p. 8; January, 1934, p. 3; February, 1934, p. 15; June, 1934, pp. 4 and 26. Farm Leaders to Roosevelt, September 25, 1933, Roosevelt Library, Official File 227XYZ.

Important support came also from the Committee for the Nation. Farm leaders had joined this organization; but business leaders, such as Frank Vanderlip, James Rand, Frederic Frazier, Lessing Rosenwald, and Vincent Bendix, dominated the group. They had the money needed to wage a costly and sophisticated pressure campaign during 1933, and these "practical men" made no attempt to hide the fact that they had adopted a program that a college professor had designed. "Had it not been that the scientific foundations for monetary reform have been laid by the economists at Cornell under the leadership of Professor G. F. Warren," the Committee's public relations expert informed Roosevelt, "even today it would not be possible to make the great step forward that lies within our reach."[34]

For a brief period, the government's response to the campaign pleased the Committee. However, in 1934 after Roosevelt turned away from Warren and stabilized the gold content of the dollar, this group tried many ways to force the Administration to return to the commodity dollar idea and to abolish the rest of the New Deal.[35] This effort included the first large attack upon the "Brain Trust" and the first widely publicized questioning of the national loyalty of important New Dealers. The public of the mid 1930's could not be frightened easily by such charges. Thus, they actually contributed to the decline and death of the Committee.[36]

The major farm groups, however, continued to support Warren and his monetary theories. When he died in 1938, the Farm Bureau pointed out that farmers of New York "had utter confidence in him, particularly in his monetary theories." The Grange declared that "he was regarded by the farm organizations as the dean of all technological, scientific and practical economic advisers."[37]

Wilson's voluntary domestic allotment plan did not gain support from farm groups as easily as did Warren's proposed commodity dollar. The latter, after all, represented but a modern version of the traditional agrarian demand for monetary inflation. Wilson's production control idea, on the other hand, ran counter to a major drive in the nation's agricultural history—the strenuous drive to expand production. Cutting

[34] Edward A. Rumely to Roosevelt, April 15, 1933, Roosevelt Library, Official File 5707. Much evidence on the Committee is available in the Warren Collection and in the Roosevelt Library, especially in Official Files 229 and 5707. Also helpful is H. M. Bratter, "The Committee for the Nation: A Case History in Monetary Propaganda," *Journal of Political Economy*, Volume 49, August, 1941, pp. 531-553.

[35] See for example the extremely interesting letter from Rumely to the members of the Directing Committee, April 12, 1934; Warren Collection, Box 16.

[36] Compare the handling of "The Wirt Case," in J. C. Malin, *On the Nature of History*, Lawrence, Kansas, 1954, with my thesis pp. 333-45.

[37] *Nation's Agriculture*, September, 1938, pp. 1-2, *National Grange Monthly*, August, 1938, p. 8.

back on production seemed sinful to some farmers. They could agree with Senator Dickinson of Iowa that "someone should take a Bible and present it to some members of the Brain Trust."[38] Wilson had looked to a tradition of the urban business world for a device for farm relief. For many years before 1933, industrial corporations had been regulating their output in order to obtain profitable prices. The voluntary domestic allotment plan represented an effort to get farmers to imitate the businessmen who controlled the nation's industries.[39]

The Montana professor believed that he had to have support from farm groups, and he worked hard and skillfully to get it. "The economists are anxious to be of the greatest public service to the leaders of the farm organizations," he wrote to some of those leaders in 1932, "and we naturally think we can be of much more service to them in the future than we have been in the past if we could get the proper hookup."[40] After Roosevelt showed an interest in Wilson's plan, the professor finally got support from those groups, especially the most powerful one—the Farm Bureau. Passage of a bill that authorized production control followed soon after he gained this support and confirmed his conception of political realities.

Wilson also worked successfully with some business leaders. Men such as Henry Harriman of the national Chamber of Commerce and R. R. Rogers of the Prudential Life Insurance company played large and important roles in the farm politics of the early 1930's. Such men worried about the inability of the farmer to purchase industrial products and to pay his debts and feared that the farmer's depressed condition might turn him in a radical direction. Thus, these businessmen backed a professor like Wilson who had a price-raising scheme that might make the farmer an effective consumer, a reliable debtor, and a political conservative.

Wilson's business supporters, especially Harriman and Rogers, contributed in many ways to his political success. They, unlike the farm leaders, were not troubled by the thought that the farmer should control his production. In fact, they helped the economist to develop his plan. They also campaigned for the plan and, most important, provided most of the financial support that Wilson received to carry on his own strenuous propaganda and lobbying efforts in 1932. It seems unlikely that Wilson

[38] *National Grange Monthly*, September, 1934, p. 10; October, 1934, p. 13.

[39] Supporters of the AAA frequently compared it with practices of industrialists. See for examples Gardner Means, "National Combinations and Agriculture," *Journal of Farm Economics*, February, 1938, pp. 53-57. M. L. Wilson, "Validity of the Fundamental Assumptions Underlying Agricultural Adjustment," *Journal of Farm Economics*, February, 1936, pp. 24-26. *New York Times*, August 1, 16, October 29, 1934; January 9, April 12, 1935; April 25, 1937.

[40] Wilson to Winder, Goss and Taber, April 11, 1932, Wilson Papers.

could have put his program across had he not received such practical help.[41]

Tugwell enjoyed less favorable relations with the major groups in farm politics. He tended to distrust them, and they tended to distrust him. Neither he nor the groups hesitated to express their feelings. The professor, for example, criticized Roosevelt's willingness to follow the lead of the farm groups in shaping farm policy. Tugwell regarded them as incapable of creating a program that would serve the national interest. Thus, while Wilson tried to work with the farm leaders, Tugwell urged Roosevelt to go over their heads and persuade the farmers themselves that production control was the most adequate proposal on farm policy. Roosevelt could not bring himself to behave in the forceful manner that the "Brain Truster" advocated.[42] Thus, Tugwell from the very beginning of his political experiences encountered difficulties that grew out of his relations with pressure groups.

Wilson, also, in spite of his ability to work with farm and business leaders, experienced frustrations. They came, for example, from the program in which he was most interested. This was a program of land use planning that included efforts to get the farmers themselves actively involved in the planning process. Both he and Tugwell looked upon the production control program as but a step in the direction of a more thoughtfully planned effort to make better use of the nation's land resources.[43] A Program Planning Division was established in the AAA in 1934 and was assigned the task of converting the farm program into something more than simply an effort to raise farm prices. In 1938, the BAE took over these duties and sought to develop more extensive land planning programs. But they, like the programs for the rural poor, soon became war-time casualties.[44]

This frustration of Wilson's hopes resulted in part from the implications of his efforts to get the farmers to participate in the planning programs

[41] The Wilson Papers for 1932 are filled with evidence on businessmen in farm politics, their reasons for being there, and the kinds of support that they gave Wilson. These paragraphs also draw heavily upon an interview with Wilson, June 29, 1956.

[42] *Democratic Roosevelt*, pp. 232-33. "Diary," December 31, 1932.

[43] Tugwell, "The Place of Government in a National Land Program," *Journal of Farm Economics*, January, 1934, pp. 59-60. "Diary," especially January 11, 1933. Wilson to E. A. Duddy, March 11, 1932; Wilson Papers.

[44] Some of the important sources for the history of these planning programs are in the *Journal of Farm Economics*. See especially, Wilson, "A Land-Use Program for the Federal Government," April, 1933. Wilson, "Nutritional Science and Agricultural Policy," February, 1942. H. Tolley, "The Program Planning Division of the Agricultural Adjustment Administration," April, 1934. F. F. Elliott, "Progress and Problems in Regional Agricultural Planning from the National Point of View," February, 1936. C. Hardin, "The Bureau of Agricultural Economics," *loc. cit.;* J. D. Black, "The Bureau of Agricultural Economics," *loc. cit.;* E. C. Banfield, "Organization for Policy Planning in the U.S. Department of Agriculture," February, 1952.

by joining farmer committees. Those efforts alarmed the Farm Bureau. That organization came to fear that the committees would reduce its importance to the Department of Agriculture and enable the government to embark upon farm programs that were not desirable from the Farm Bureau's point of view. This farm group had the power required to destroy the committees before they did develop along such lines. By 1940, an attack was under way. By 1942, the land-use planning committees went under. Then the central planning agency—the BAE—was whittled down and finally dismembered—a process that took a decade and was actively pushed by the Farm Bureau.[45]

This powerful farm organization recognized, perhaps more clearly than Wilson, that what he had actually proposed was a change in the power arrangements of farm politics. The farmer committee idea meant that farmers should engage in politics much more actively and in much greater numbers. And as a consequence of greater political participation, Wilson assumed, agricultural planning would get valuable ideas and vigorous support. Wilson insisted that "unless plans have a democratic base, are understood, appreciated and wanted by the rank and file of the farmers they will not serve the best purpose." He believed, furthermore, that if the farmers got "the facts" they would be able to "see their real interests far more clearly." They would then participate in "self-conscious, alert, well-informed and socially inspired groups of rural people" to devise plans that would promote those interests. The government, in short, was to promote the development of a powerful rural social movement for planning purposes.[46]

Wilson's efforts to change power arrangements failed. Failure also greeted Tugwell's quite different efforts to accomplish a similar purpose. The Montana professor worked on this matter, as on all others, in cooperation with established groups. He believed that change could only proceed slowly.[47] Thus, the Extension Service, a close friend of the Farm Bureau, played a leading role in the development of the committees. Tugwell, on the other hand, proposed a much more open and vigorous attack upon

---

[45] Hardin, "BAE under Fire," *loc. cit.*, pp. 636-39, 643, 646-51, 655-58, 665-68. Hardin, *Agricultural Education*, pp. 155-74, 177-84, 247, 251-57. Hardin, *The Politics of Agriculture; Soil Conservation and the Struggle for Power in Rural America*, Glencoe: The Free Press, 1952, pp. 135-36, 260. Wesley McCune, *Who's Behind our Farm Policy.*, New York: Praeger, 1956, pp. 259, 322-24.

[46] Wilson to W. R. Ronald, August 3, 1934; National Archives, Records Group 16, Secretary's Correspondence, AAA. Wilson, "The Place of the Department of Agriculture in the Evolution of Agricultural Policy," National Archives, Records Group 83, General Correspondence, Division of Statistical and Historical Research. Wilson to Jay Whitson, November 2, 1936; National Archives, Records Group 16, Secretary's Correspondence. Interviews with Henry A. Wallace, June 12, 1958, and John D. Black, June 17, 1958.

[47] Wilson to the author, August 10, 1956.

existing power arrangements. He insisted that the party system had to be reorganized so that the country could get the economic planning that it needed.

The Columbia professor's proposal reflected his understanding of power realities. His experiences in government convinced him that powerful groups opposed economic planning and efforts to elevate lower income groups. He noted, for example the weak political position of the people served by the Resettlement Administration:[48]

> Many of the clients cannot, or at any rate do not vote and so, especially in the South, the politicians can afford to call them lazy, shiftless, no-account. The efforts toward farmer-aid can more profitably go to the better citizens among the rural folk who can be expected to suitably repay political efforts in their behalf.

Because much of the oposition came from powerful members of the Democratic party such as Senators Byrd, Bailey, Smith and Glass, Tugwell concluded that the country could not rely upon its existing party organization. A progressive party had to be created that would provide the power needed to proceed democratically toward the abolition of "industrial autocracy" and the establishment of "democratic discipline." He called for this development in a vigorous speech in Los Angeles in the fall of 1935. The new party, he declared, had to be based on an alliance between farmers and industrial workers. Those groups were the "natural progressive allies" for they stood to gain most directly from the proposed changes. Such an alliance, he predicted, would "reduce our dependence on half-way measures and allow us to carry through those reconstructive ones both in agriculture and in industry without which our nation cannot continue either free or prosperous."

Tugwell expected that powerful opposition to this proposal would come from businessmen and conservative farm organizations such as the Farm Bureau. But he believed that the change could be made—and made peacefully—if a leader worked to make the farmers and workers more fully aware of their common interests and to keep them united. "The La Follette following is enough to prove," he argued, "that farmers and workers will unite when a coherent program which appeals to both groups is presented and when the leadership is adequate."[49]

Roosevelt encouraged the professor for he had long had doubts about the value of the existing parties. As President, he cooperated with progressive Republicans such as LaFollette, Norris and La Guardia; and in 1938 Roosevelt entered the primary elections in an effort to "purge" from

[48] *New York Times*, January 10, 1937.

[49] "The Progressive Task Today and Tomorrow," *Vital Speeches*, December 2, 1935, pp. 130-35. "Is a Farmer-Labor Alliance Possible?" *Harper's*, May, 1937, pp. 651-61.

his party congressmen who had defeated various New Deal proposals. The failure of the "purge" and the outbreak of the war caused Roosevelt to drop his efforts to reshape the parties. He needed the support of the southern conservatives who had great power in Congress and a strong interest in international affairs. In 1944, however, he returned to the idea and even negotiated with Wendell Willkie in hopes of creating a progressive party that would support both international cooperation and domestic reform.[50] These activities convinced Tugwell that had Roosevelt "lived to run for a fifth term . . . it would not have been as a Democrat, but as a Progressive."[51]

Roosevelt had a sincere interest in party reorganization, yet it seems unlikely that he would have ever worked hard at the task. Such work would have involved a conflict with his usual behavior in relation to the established power groups. His tendency was to secure the cooperation of as many of them as possible, while Tugwell's proposal challenged the basic orientation of the most active and powerful groups in farm politics.

Many of those groups, especially the business groups, sought an alliance between businessmen and farmers and hoped to prevent farmers from allying with urban workers. Thus, Tugwell's proposal shocked some of the most militant representatives of the business point of view in farm politics. Robert Wood of Sears, Roebuck, Inc. for example, warned Roosevelt and Wallace that no one but "extreme radicals" liked the professor's ideas. "No more vicious speech was ever delivered," Wood insisted, "than the one Mr. Tugwell delivered in Los Angeles when he called on the farmers and the workers of the country to unite, practically urging them to revolution."[52] Perhaps only a farmer-labor alliance could have enabled Tugwell to realize his ideas. But Roosevelt could not have built a party on such a base unless he had been willing to fight powerful men and groups.

The experiences of Wilson and Tugwell, then, suggested the great difficulty of changing power arrangements; and the experiences of all four men demonstrated the importance of power relations to the policy-oriented economist. The pluralistic and somewhat flexible power structure in America allowed these economists some freedom of action in politics. They could work to arrange various power alliances in order to translate

---

[50] *Democratic Roosevelt*, pp. 227, 247, 358, 409-27, 449, 461, 468-78, 506-08, 523-25, 532-33, 542, 548, 563, 611-13, 623-26, 643-77. Schlesinger, *Crisis of the Old Order*, pp. 102-04.

[51] *Democratic Roosevelt*, p. 410.

[52] Wood to Roosevelt, November 25, 1935; Wood to McIntryre, October 21, 1936, Roosevelt Library, President's Personal File, 1365. Wood to Wallace, October 16, 23, 1936; National Archives, Records Group 16, Secretary's Correspondence, Politics. See also, George Peek, *Why Quit Our Own?* New York: Van Nostrand, 1936, p. 121 and *Farm Journal*, January, 1936, p. 18, February, 1936, p. 21.

their ideas into policy. But power arrangements placed definite limits upon the economists' opportunities for success. The power realities of a quarter century brought greater success to Myers than to Tugwell. Even the more conservative Cornell economist, however, experienced some defeats. It would seem, on the basis of the fairly wide-ranging points of view represented by these four men, that all economists with an interest in policy must expect that their experiences would at best be a mixture of success and failure.

The four economists may have failed to solve the nation's "farm problem," but nevertheless they are worthy of praise for two extremely important reasons. First of all, they responded to a call that some members of their profession must always be prepared to accept. Economic problems almost inevitably become political problems and consequently require that some economists get involved in policy making. Furthermore, policy making can benefit from the participation of economists only if they function critically. They must resist the pressure upon them simply to provide economic rationales for the interests of pressure groups. These four economists did criticize men of power when those men conflicted with the economists' conception of sound economics. In short, the experiences of these four men testified to the value of a profession that can produce men capable of performing service and critical functions in the political process.

TOWARDS AN INTERNATIONAL DIMENSION IN AGRICULTURAL ECONOMICS

LAWRENCE WITT*
Michigan State University

WERE any of us to stroll across the campus and ask the anthropologists about the competent people in their field, the vast majority of the names mentioned would have had foreign experience or experience in a cross-cultural situation. It would seem that nearly all of the better anthropologists seek assignments in other countries; or else it is not possible to become a competent anthropologist without having experience in another culture. Visit next in the political science department. They would tell you that among the younger men receiving recognition, many, though by no means all, have foreign experience.

Turn then to the physics or chemistry departments and ask individual members about the research reports they have studied recently. Many of the articles read, probably as abstracts, were written by their counterparts overseas. Moreover the ability to read in the original German or French is valued far more highly than it is among agricultural economists.

Think now of the members of your staff or associates in agricultural economics who have been overseas recently. How do you evaluate their experiences? How do they rate their own contributions? How does the profession judge them? Think also of your own reading. As a normal part of your work is it necessary to read, in abstracts or otherwise, about agricultural economic research being done in Europe or in Asia?

Undoubtedly there is a considerable dispersion in the attitudes towards overseas work. Nonetheless it appears that a substantial number of replies would run along the following lines. "He wasted two years of his professional life." "It was an interesting, arduous, but purely personal assignment." "He made a substantial contribution to the program in . . . country, but his program of work here was set back three years by his absence." A few might even say that the overseas experience has ruined him for making a contribution in the United States. It may be hazarded that reading about agricultural economics work elsewhere will be much more limited than in chemistry and physics. A major part of such reading will be contributions of foreign authors to American journals, or general economics articles published in two or three prominent foreign journals. The number of agricultural economists who read journals in languages other than English undoubtedly is very small.[1]

---

* I should like to thank Raleigh Barlowe, Lawrence Boger, James Bonnen and Dale Hathaway for incisive comments on an earlier draft of this manuscript.

[1] A recent survey among Harvard doctorates indicates that social scientists are much less likely to use languages than either the physical scientists or those in the humanities.

If these statements are reasonably accurate, they raise questions which the profession should consider seriously. Is agricultural economics of necessity culture-bound and ethnocentric? Are the principles we espouse so culture-derived that they have no universality? Can an international dimension be built into agricultural economics, with professional advancement and higher status conferred by doing a top-notch job in India, Japan, Latin America or elsewhere? How can the problems and contributions of our professional colleagues in other countries be recognized? Must this work be done by special international agricultural economists unable to move back or forth from state and national to international programs? Can such shifts be made only by senior men with established reputations in the domestic scene? How can competent foreign consultants be developed?

This article is written to pose a challenge to the profession. The author is by no means clear as to the proper answer or procedures. What is clear is that there have been enormous international challenges (described below) to agricultural economics for more than a decade, and that they are likely to become more, rather than less, acute in the years ahead. While many agricultural economists have been drawn into programs overseas, the on-campus research, teaching, and extension activities within the universities have adjusted to only a limited extent. What are the implications to the profession of agricultural economics in general and to individual members in particular?

Expanding International Responsibilities

During the past 40 years the United States has undergone a revolution in its relations to other countries. It is now one of two major world powers actively engaged in a struggle for the minds and hearts of people all over the globe. We have come to a grudging acceptance of a major responsibility to play a primary leadership role in the free world. Implementation of this role requires a wide diversity of programs. Effective operation of many of these programs requires knowledge and techniques within the purview of agricultural economics. Among them are the following.

An international dimension is already present in our work, though only to limited extent. Assumptions about war and peace or something in between are regularly made in presenting the economic outlook. But how frequently do we go behind the assumptions and provide our audience with a background against which they can evaluate current events in the international arena?

Extension meetings on farm policy can involve considerations of tariff and trade policies. The continued existence of agricultural surpluses and

the farmers' own moral values bring a concern for "ill-fed millions in Asia" into many agricultural discussions, implicitly if not explicitly. But how fully do we give consideration to the moral values of America's own policies of exporting, yet hesitating to import? Are we providing farm leaders with information which will enable them to understand better the relationship of domestic policy to foreign policy? We ourselves do not even know the effects of our export programs.[2] Are most of our students well-equipped to analyze such problems?

The wide fluctuations in the prices of internationally traded raw materials pose serious questions for many countries. The reasons stem from the same whiplash of the business cycle through sticky marketing spreads with which our United States farmers are only too familiar. However, with the national welfare of many countries dependent upon one or two export commodities, the challenge for solution becomes even more acute than in American agriculture. Farm groups in the United States should be able to understand the problems posed by these instabilities. Agricultural economists should be able to develop alternatives which go beyond diversification and self-sufficiency.

Perhaps most important of all are the challenges involved in the economics of development. Many nations, developed and underdeveloped alike, are interested in programs and policies which will raise the level of living of farmers and of the whole society. Specific programs take many forms—from manipulating the rural-urban and import-export terms of trade by monopolistic means, through the creation and distribution of new technology, to massive programs of capital investment in irrigation projects, fertilizer plants, transportation facilities and marketing organizations. With the income of so many people in so many countries primarily dependent upon agriculture, it is clear that economic development programs must in some measure—not yet well-understood—give cognizance to agriculture. Perhaps both our domestic and foreign students would benefit if we embraced these problems more fully. There are many parts of American agriculture which still present puzzling relationships. These may become clearer as we more completely understand development problems.

More evident to the members of our profession in academic institutions are the university contracts with government and foundations. Some of these programs have required agricultural economists, but many rightly have emphasized technical phases of agriculture. As the knowledge of improved technological processes becomes more available within these

[2] For a development of this view see my statement in *Policy for Commercial Agriculture*, Joint Economic Committee, 85th Congress, 1st Session, November 22, 1957, pp. 585-98 and *Hearings*, December 16-20, 1597, pp. 271-4.

countries and is communicated to the farm operators and marketing agencies it is likely that balancing inputs will become more important. Investments in new fertilizer plants need to be compared with investments in additional machinery and equipment, with investments in irrigation projects, land clearing and drainage, and with investments in export industries and an increased importation of agricultural products.

It can be argued that in many countries a detailed knowledge of the nature of the production function is of more significance to state and national planning agencies than as advice to the millions of small farmers moving from subsistence farming toward commercial agriculture. While this information may be helpful to individual farmers, it is likely that the extension and community development programs should continue to be heavily oriented to new (to the farmer) technological processes—with these general lines of activity guided by over-all economic relationships. With the paucity of resources available there is a heavier premium upon economical and efficient research and informational activities. They cannot afford wasteful research; yet they cannot afford not to create new technology either. Macroanalysis, based upon much more adequate micro data, may well become one of the important ways in which agricultural economists are called upon for assistance in the next decade.

Another challenge to the profession lies in the entire area of the relation of man to land. The appeal of land ownership, the conflicts between landlord and tenant and the lack of incentives with traditional patterns of sharing certainly underlie much of the political instability in the less developed nations. Land reform is a many sided problem. Its effects on productivity are different in the short run and long run. Incentives for agricultural improvements are certainly greater when the operator's bundle of rights is expanded. The complex of equity problems viewed in the present context and in its historical dimension provide a fascinating panorama for study. Add to this the real, the vital, the raw political forces which surround land ownership and land reform in so many developing countries! Along side of these problems, the projects with which many U.S. agricultural economists deal seem almost pitifully unimportant.

The work being carried on directly by the International Cooperation Administration (ICA) and by a number of foundations involves a diversity of talents. More agricultural economists are being assigned overseas. Many of these, of course, are under a more or less permanent commitment in any one of a variety of fields. Universities have a responsibility in the training and development of personnel for such operations, just as they have accepted a responsibility in the training of students from overseas. Have adequate courses and curricula been developed to meet the needs of people with these interests?

Fully familiar to campuses all over America are the foreign students and visitors. Many receive part of their training by observing and participating in classes, extension meetings and research projects. Even with adaptation, much of the material is of limited usefulness to the foreign student. Many of our courses in marketing, policy and farm management are in themselves intimately related to our economic, social and political structure. Knowledge of a futures market for grain has little application for a society where three-fourths of the people are self-sufficient farmers and sell only when they have a surplus over consumption needs, or need cash for taxes or a wedding. Similarly farm management work oriented to a commercial farm economy which is comparatively short on labor and long on machinery must seem fantastic to an Asian student. The point to be made is that too much emphasis may be placed on describing and examining a culture-bound problem rather than emphasizing those analyses and methods which have more general application.

Taking account of these challenges requires an allocation of time—by the individual and by the institution. It may involve cumbersome administrative arrangements as well as complications and risks in providing secure positions. The individual is unable to respond enthusiastically to these challenges unless, among others, most of the following conditions are met: (1) The combination of security, salary and satisfactions is as great as with alternative positions; (2) The job presents professional challenges and interests him personally; and (3) The recognition of his contribution (or lack of it), both by his administrators and by his colleagues, is equal to alternatives. The first of these is heavily but not exclusively the responsibility of the institution for which he works. The second is shared between the institution and the individual. The third falls upon the institution and the profession.

Desirable Administrative Responses

To give content and substance to an international dimension in agricultural economics requires imaginative ideas from individual members of the profession and the staffs of the agricultural colleges. Administrative procedures on campus and in Washington can facilitate and encourage the development of programs or they can stifle or delay such activities. Looking first at the overseas contracts, one finds several key considerations. First, there are positive gains to the institution and to the individual if staffing can be geared into the long-time development of the program and the department. This means that a large part of the staffing should be done with personnel who now are or who will become a permanent part of the campus program. This will make possible a better quality

staff overseas and help qualify the staff for a role in later campus programs dealing with international agricultural problems.

Secondly, it is desirable to build and develop job assignments which integrate the overseas and campus assignments. There are many ways to create greater complementarity. While the individual may gain perspective and understanding as a result of spending two years in Denmark or Brazil, the payoff to the university is small unless this talent is used in campus activities which are new and different.

Thirdly, there seem to be many good reasons for developing a fuller research dimension in the activities overseas. In this way a larger scope for meaningful professional contributions can be provided. The ICA often is loath to grant funds for this purpose, yet the experience of many agricultural economists (and other agriculturalists) in research should make it possible to develop worthwhile projects, both in their own right and as demonstrations of how to do research. Foreign or American students working on Ph.D. theses might equally well be brought into working relationships with agricultural economists functioning overseas. The completed and published work would permanently contribute to our understanding of cross-cultural problems or developments in another economy.

An important problem is money to defray the costs of this work. One can argue that the international interests of the people of each of our states are such that only a small fraction of the state funds can legitimately be used for such activities. While true, this is not an easy argument to implement. Fortunately there are other sources available where the college and Washington administrators bear more responsibility. With billions of dollars worth of agricultural commodities being sold for local currency, it should be possible to use some of this currency for studies related to these programs and to other interests of the United States. The State Experiment Station Division (SESD) could assist various stations in obtaining local currency to defray the overseas research costs of an approvable project. Furthermore, there seems to be no legal reason why there could not be additional dollar allocations to underwrite travel to and from the country in question as well as the time needed to prepare for publication in the United States. The land grant colleges ought to insist that the SESD take leadership in facilitating this development. In addition, there exists the opportunity for foundation grants to expand the work beyond that provided by ICA.

One further point, the individual staff member who takes a university overseas assignment or other position involving an international dimension should receive the same considerations as other staff members in recognition of his work. While he may receive extra allowances because

he is overseas, he should receive normal adjustments in rank and salary based upon his contribution to the total university program. Progression towards a tenure position should not be withheld; nor should the other subtle but nonetheless important attributes of academic life be any more limited than necessary.

Individual Participation in International Programs

The range of adjustments required to give cognizance to an international dimension in agricultural economics is wide indeed. For some workers no adjustments appear to be needed other than library and research materials. The considerations of tariffs, imports and exports, stage of the business cycle in other countries and the level of economic development are but additional factors which must be brought into any sophisticated analysis of the current and future economic situation. At the other extreme are those who take on government or foundation positions with nearly continuous assignments overseas, and whose ties to the profession sometimes stretch very thin. In between are all varieties of short-term and medium-term commitments, long-term allocations of part of one's time, etc.

The decision of the agricultural economist contemplating an overseas post would be less difficult if there were domestic positions for which foreign experience is an additional qualification. A good case can be made for one or two positions in many extension services dealing with over-all politico-economic forces overseas and with competitive forces affecting major farm commodities. Similarly experiment stations might have positions in which part of the research task is keeping abreast of the developments in other countries which affect the welfare of their state. (And what developments do not in this complex world?) The argument here, of course, is that universities need to redefine jobs in the interests of the people they serve. Creating such positions would provide opportunities for the formal or *de facto* exchange of personnel between such on-campus positions and international assignments. Several branches of government now have provisions for refresher courses and for the allocation (or exchange) of permanent personnel to jobs in the United States, preferably in a college or university. This enables them to devote a year to become reacquainted with American agriculture, technical developments and the American value system. There would be mutual benefits from such exchanges which would counter some of the difficulties in making the arrangements. Yet under present job definitions, many administrators would argue that such exchanges would weaken rather than strengthen campus programs.

Then there are the problems of people who devote part of their life

to some overseas program. The young married man usually can work abroad with less complications in children's health and education. Moreover he and his wife tend to be more flexible and adaptable. Yet government hesitates to hire young people, preferring to take someone whose ability to perform is established. Some other agency or institution should take the risks! If the young Ph.D. does take an overseas assignment for two to five years and then tries for an academic job, he is likely to find the going tough, the salary offers modest and lower than his fellow graduates who stayed home.

So the man waits until he is 35 or 40. By this time his children are in or about to begin high school.[3] He has interests and commitments in established projects. His department head and dean are reluctant to see him go (if he is the kind of man who should be asked to go), and he often sees relatively little opportunity in the assignment as a means of growing into a better man in a more responsible position. He is not even sure that he will receive normal raises while gone, or whether another staff member will take over the most interesting part of his present duties. In some cases a university or foundation will recruit a man for a specific two-year assignment with no commitment or responsibility for his future. This would seem to be the worst of all possible arrangements both for the individual and the sponsoring agency.

These are simple facts and become obvious as soon as one examines them. To improve the situation, however, is less simple. The government and universities need to take the staffing job for international work seriously. They need to seek arrangements which provide flexibility with security. A flow of people willing to accept short-term assignments will not provide the international programs which America needs today. Some personnel need to be given training which will enable them to move overseas directly and make an important contribution. There needs to be a welcome for them in well-paying positions on our staffs after two, six or 10 years in such work—well at least after two to six years!

Challenge to the Profession of Agricultural Economics

Can anyone define the process by which an agricultural economist gains recognition as an important contributor? Some recognition comes from giving papers which stimulate and perhaps provoke debates. Some comes from articles in the various journals. Some comes from performance in teaching students, in committee meetings, or in discussions with colleagues. Much of it comes by word of mouth stemming from such activities. But this procedure works more effectively for U.S. centered pro-

[3] This is a particularly inappropriate time to move a family into most underdeveloped countries.

grams than for overseas programs—our communications with and about the nature and performance of those working overseas does not permeate the profession.

There probably are a number of reasons for this. First, home leaves or home assignments seldom provide an adequate opportunity to attend and participate in annual meetings, committee discussions and program planning. Administering agencies and institutions can provide some help in making such participation feasible and essential.

Second, as individuals we can make special effort to open communication channels with or about people working in international aspects of agricultural economics. Perhaps a special section of News Notes which involves a discussion of such assignments and major accomplishments would be helpful. Accepting a paragraph or two discussing the work instead of two sentences stating that "X" is going to Iran, would provide more information. Perhaps it also would be possible to find some way by which recognition of a job well done can more easily permeate the profession. Statements like "I hear you did a bang-up job on that Chilean assignment," should be part of the professional gossip just as much as comments on the speech to an agricultural organization, or a recent bulletin. How we should move toward this situation is hard to say.

Third, the individual who goes overseas should try to inform the profession of how he handled certain problems and publish information about results accomplished. The number of publications (which his colleagues see) coming out of four years of work in Asia or Latin America appear to be a small fraction of what is forthcoming out of the same amount of time and quality of worker functioning within the United States.

This appears to be because the individual does not write as much (or as well) for (American) publication. Part of the fault, however, may lie in our willingness to read such articles, or hesitation in asking for an article. For example, in the Joint Economic Committee hearings in late 1957 no one was asked to fly to Washington from an overseas post to present information on the foreign market for agricultural products. (Presumably foreign reports were digested in a Foreign Agricultural Service statement.)

Final Statement

This article raises questions rather than answers them. The United States faces a major challenge in international relations in the world today. Much of government and many major business firms have developed operating structures giving content to the international problems.

The universities of America are just beginning this process. For the

most part they are reacting to a series of random suggestions, and hastily planned commitments. They need to initiate and develop a consciously integrated program at least as carefully as they consider traditional university programs. Certainly with present foreign aid, student exchange and technical assistance programs, the international emphasis is not limited to anthropologists, some political scientists, and language teachers. Universities and the various disciplines and professions need to consider how they can take cognizance of and build an international dimension into the warp and woof of the institution and discipline. International relations are too important to be left to a small group of statesmen and scholars. They need to become a part of all of our efforts in the same way as mass education and later adult education have become an integral part of our colleges and of our society. How do we proceed?

A GENERALIZATION OF THE WORKING METHOD FOR ESTIMATING LONG-RUN ELASTICITIES[*]

George W. Ladd and John R. Tedford
Iowa State College

A POINT often expressed is that the elasticity of demand for a commodity will increase as the length of the time period is expanded. Although numerous studies have been made to obtain statistical estimates of price and income elasticities of demand, it can be argued that these studies have been concerned primarily with estimates of short-run elasticities. Short-run elasticities are important, but as Wold and Jureen point out it is the long-run elasticities of demand that are of primary importance in the practical application of demand analysis.[1]

It is only in recent years that studies have been designed and directed to obtain quantitative estimates of the long-run elasticities of demand. Koyck,[2] Nerlove[3] and Hildreth and Jarrett[4] have proposed one method of estimating long-run elasticities. Working has used a different method and this paper will discuss only this procedure as it is the one which has provoked the most controversy.[5]

Underlying the estimation of long-run demand elasticities is a model specified in line with dynamic economic theory. Working points out that the relevant concept of economic dynamics is one where there are important lags operating upon the economic variables. He states,[6] "It is true that the aggregate quantity of a commodity consumed in any one year may have been influenced by prices, by incomes, or by general price levels of previous years. . . . , we should not consider that we have discovered a dynamic elasticity unless we have found a basis of estimating how the quantity demanded responds to income or to price in varying degrees depending upon the lapse of time."

---

* Journal Paper J-3478, Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa, Project 1355.

1 H. Wold and L. Jureen, *Demand Analysis*, New York: John Wiley and Sons, 1953, p. 227.

2 Koyck, *Distributed Lags and Investment Analysis*, Amsterdam: North Holland Publishing Co., 1954.

3 Marc Nerlove, "Distributed Lags and Estimation of Long-Run Supply and Demand Elasticities: Theoretical Considerations," *Journal of Farm Economics*, May, 1958, pp. 301–311. *Distributed Lags and Demand Analysis for Agricultural and Other Commodities*, Agriculture Handbook No. 141, Agricultural Marketing Service, 1958.

4 Hildreth and Jarrett, *A Statistical Study of Livestock Production and Marketing*, New York: John Wiley and Sons, 1955, pp. 112–113.

5 E. J. Working, "Appraising The Demand For American Agricultural Output During Rearmament," *Journal of Farm Economics*, May, 1952, pp. 206–224. *Demand for Meat*, Chicago: University of Chicago Press, 1954. "How Much Progress Has Been Made in the Study of the Demand for Farm Products?" *Journal of Farm Economics*, December 1955, pp. 968–974.

6 E. J. Working, "Appraising The Demand For American Agricultural Output During Rearmament," *Journal of Farm Economics*, May, 1952, p. 217.

The presumption that the lag in consumers' behavior is not sufficient to be reflected when using annual data has been accepted by some persons; however, Working claims that for meat products this is not the case. As evidence he states, "A smaller percentage change in price is associated with a one per cent change in the five-year average consumption than with the percentage which the given year is of that five-year average. Therefore, we may presume that in the long run, the demand for meat is less inelastic than in the short run."[7] In order to obtain estimates of short-run and long-run elasticities of demand, Working separates consumption into two components, Q and q. These are, respectively, the logarithm of average consumption over the preceding five years and the logarithm of current consumption. He estimates equations of the type

$$P = b_1 Q + b_2(q - Q) \tag{1}$$

where P is log of current price, and maintains that the short-run price elasticity is b_2^{-1} and the long-run price elasticity is b_1^{-1}.

Working's interpretation of the long-run elasticity of demand has been questioned by Kuznets and O'Regan. In reviewing *Demand for Meat*, O'Regan states,[8] "He (the reviewer) is unable independently to determine the theoretical considerations that led the author to use these estimates. Two points are focal: (1) The idea that a long-run demand curve can be estimated from the net regression of the yearly index of deflated price on the average per capita consumption of the preceding 10 years does not possess strong intuitive appeal. (2) The author implies that

$$\frac{\partial P}{\partial Q} \cdot \frac{Q}{P} = b_1$$

to the reviewer it seems that

$$\frac{\partial P}{\partial Q} \cdot \frac{Q}{P} = b_1 - b_2."$$

(O'Regan uses P, Q and q to represent actual values.) Kuznets' criticism is much the same as that of O'Regan.[9] He also questions the use of the coefficient associated with average consumption to obtain estimates of long-run elasticity.

In recent papers, West[10] and Gislason[11] have commented upon Kuznets'

[7] *Ibid.*, p. 218.

[8] W. G. O'Regan, "Review of Working's *Demand for Meat*," *Journal of Farm Economics*, November, 1955, pp. 752–755.

[9] G. M. Kuznets, "Measurement of Market Demand with Particular Reference to Consumer Demand for Food," *Journal of Farm Economics*, December, 1953, pp. 878–895.

[10] V. I. West, *The Long-Run and the Short-Run in Demand Analysis*, Urbana: University of Illinois Agricultural Economics Report AERR15, February, 1957.

[11] C. Gislason, "A Note on Long-Run Price Elasticity," *Journal of Farm Economics*, August, 1957, pp. 798–802.

and O'Regan's criticisms and have defended Working's conclusions. West has presented an interesting interpretation of Working's argument. Modigliani and Brumberg argue that the conventional definition of marginal propensity to consume, $\partial C/\partial Y$, should be replaced by a total derivative

$$\frac{dC}{dY} = \frac{\partial C}{\partial Y} + \frac{\partial C}{\partial Y^e}\cdot\frac{dY^e}{dY}$$

where Y^e is expected income and dY^e/dY is to be determined empirically.[12] Analogously, West defines elasticity as the reciprocal of a total derivative,

$$\frac{dP}{dQ} = \frac{\partial P}{\partial Q} + \frac{\partial P}{\partial q}\cdot\frac{dq}{dQ} = b_1 - b_2 + b_2\frac{dq}{dQ}\cdot$$

Since Working has defined the long run as a period when $Q=q$, $dP/dQ=b_1$

Both West and Gislason assume the Working equation and then discuss its interpretation. Thus far no one has presented the "theoretical considerations that lead [Working] to use these estimates."[13] The main objectives of this paper are to derive the Working equation from a set of basic assumptions, to derive a generalization of his method and to present some comparative results. This procedure lays out the special assumptions implicit in the Working method.[14] A secondary objective is to present a conceptual framework for distinguishing short-run and long-run elasticities.

Conceptual Framework

The basic hypothesis underlying the study of long-run elasticities is that there is a perceptible lag in consumers' adjustments to changes in prices, incomes or other factors, i.e., that consumers do not move immediately from one equilibrium position to another when a change occurs. It appears reasonable that the complete adjustment should be spread out over time when we are dealing with such aggregates as market demand, which is considered as the sum of individual demands. Some individuals may react immediately to a change whereas others may respond so slowly that their adjustment will not be completed until several periods after the initial change in a demand determining variable. Some of the possible reasons for such lags are:

(1) Some consumers buy on the basis of habit. Some time will be required for the change to be appraised and for the consumer budgets to be adjusted.

---

[12] F. Modigliani and R. Brumberg, "Utility Analysis and the Consumption Function," Chapter 14 in *Post Keynesian Economics*, K. K. Kurihara (editor), New Brunswick: Rutgers University Press, 1954.

[13] W. G. O'Regan, *op. cit.*

[14] The Working equation can also be derived as a special case of the Koyck argument; this derivation points out the same implicit assumptions as the derivation presented here.

(2) Some consumers will not become aware of the change for quite some time after it has occurred.

(3) The nature of the good may be such that it requires complementary goods in consumption or it must be worn out before a new one will be purchased.

(4) Large debts incurred in the past may inhibit changes in current consumption patterns.

The basic hypothesis can be stated symbolically as $q_t=f(p_t, p_{t-1}, p_{t-2}, \cdots, p_{t-n})$ where current demand is written as a function of current and lagged prices, indicating that the level of current demand is composed of the consumers' adjustment to current price levels and of their current adjustment to prices existing in past periods.

The price, income or other elasticities of demand are defined as the logarithmic derivatives of demand with respect to the relevant variable. Applications of this concept generally follow classical static theory in that the influence of time is ignored. When time is explicitly introduced in the specification of the demand curve we must turn to dynamics. When lagged values of price, income or other explanatory variables are specified in the demand equation, indicating that the consumer's adjustment to a change in such variables requires more than one time period to be completed, we can define price or other elasticities with respect to the time periods to which the reaction relates. It is in keeping with the static, equilibrium nature of classical theory to restate the definition of elasticity as the partial logarithmic derivative of the equilibrium quantity demanded with respect to the relevant variable. Here equilibrium quantity for a given value of the relevant variable refers to the quantity corresponding to that value on the static demand curve. We will adopt this as our definition of long-run elasticity.

Assume that demand can be written as a function, linear in the logarithms of current and past prices

$$q_t = a + a_0 p_t + a_1 p_{t-1} + a_2 p_{t-2} + \cdots + a_n p_{t-n}. \tag{2}$$

Figure 1 can be used to show that the long-run price elasticity is

$$e_{LR} = \sum_{i=0}^{n} \frac{\partial q_{t+i}}{\partial p_t} = \sum_i a_i. \tag{3}$$

Figure 1 is drawn to represent a situation in which price has been a constant for all periods $t \leq -1$, price increases between periods -1 and 0 and then remains constant at the higher level. The units of measurement are so chosen that $p_{-1}=p_{-2}= \cdots =0$ and $p_0=p_1= \cdots =1$.[15] The course of p_t

[15] These units of measurement, chosen purely for convenience, may seem unrealistic. What this amounts to, however, is merely a coding of the units of measurement. Suppose price rose from 86 cents to 89 cents; two steps are involved in the coding. (1) Subtract 86 cents from each price. Then 86 cents minus 86 cents = 0 is the measure of initial price. (2) Set 89 cents minus 86 cents = 3 cents = 1 monetary unit. Then the new price is 1.

over time is shown by the solid line p_t; the time path of equilibrium consumption, $\bar{q}$, is the solid line labelled $\bar{q}$. The equilibrium level of consumption changes simultaneously with the price. If consumers adjust immediately, the course of actual consumption will coincide with the course of equili-

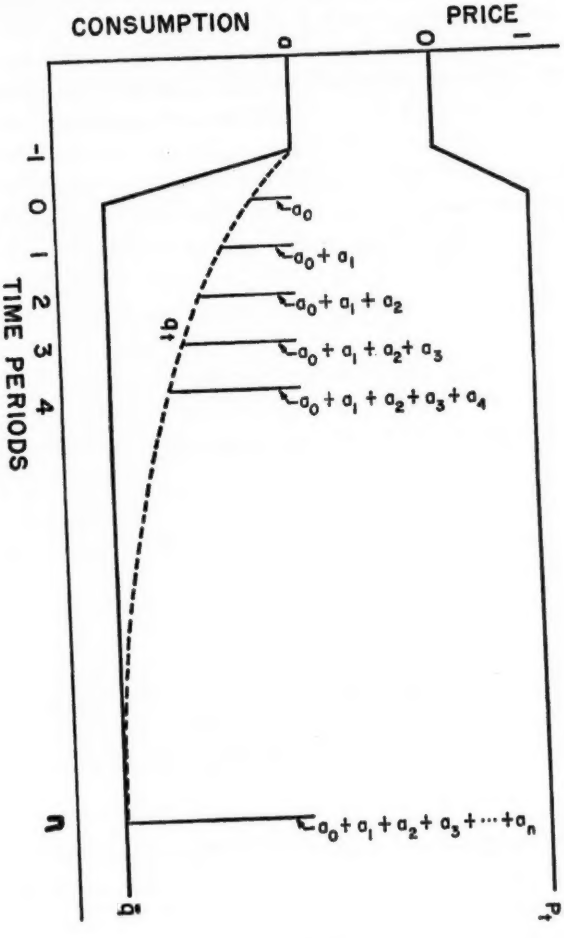

FIG. 1

brium consumption. If consumers achieve the new equilibrium level of consumption only after n+1 time periods, the time path of actual consumption would be represented by a curve like the dotted line q_t.

The initial level of consumption is given by

$$q_{-1} = a + a_0 p_{-1} + a_1 p_{-2} + \cdots = a. \tag{4}$$

Writing only the non-zero terms in the equations for $t \geq 0$, we obtain from (2)

$$q_0 = a + a_0 p_0 = a + a_0 \tag{5.0}$$

$$q_1 = a + a_0 p_1 + a_1 p_0 = a + a_0 + a_1 \tag{5.1}$$

$$\vdots$$

$$q_n = a + a_0 p_n + a_1 p_{n-1} + a_2 p_{n-2} + \cdots a_n p_0 \tag{5.n}$$

$$= a + a_0 + a_1 + a_2 + \cdots + a_n.$$

Subtracting (4) from (5.j) it is seen that the quantity changed from period -1 to period j is $\sum a_i$, $i=0, 1, \cdots, j$. If the new equilibrium level is stable, actual consumption will approach it gradually over time. After $n+1$ periods actual consumption will equal equilibrium consumption and the change in actual consumption from period -1 to period n will equal the change in equilibrium consumption from period -1 to period 0.[16] The change in actual consumption will be $\sum a_i$, $i=0, 1, \cdots, n$, which is then the long-run price elasticity in accordance with the previous definition.

$$e_{LR} = \frac{\partial \bar{q}}{\partial p_t} = \frac{\bar{q}_0 - \bar{q}_{-1}}{p_0 - p_{-1}} = \frac{q_n - q_{-1}}{p_0 - p_{-1}} \tag{6}$$

since $\bar{q}_0 = \bar{q}_n = q_n$ and $\bar{q}_{-1} = q_{-1}$. These results can also be shown to apply when price continues to change.

If we define the short-run elasticity of demand as the change in consumption resulting contemporaneously with the change in price, the short-run elasticity of demand is

$$e_{SR} = \frac{\partial qt}{\partial p_t} = a_0. \tag{7}$$

If the consumer responded immediately and achieved the new equilibrium contemporaneously with the price change, the time path of actual consumption would be $\bar{q}$, and a_0 would be the long-run elasticity.

Derivation of a Generalized Procedure

In order to obtain empirical estimates of long-run elasticities of demand, some approximation must be specified as representing the adjustment path of consumers' behavior. It would be a difficult job to obtain estimates for each of the coefficients in an equation such as (2). The Working procedure reduces the number of coefficients to be estimated and probably eliminates some of the statistical problems, such as multicollinearity, encountered in estimation. We will first derive a generalization of the Working procedure and then will show how his procedure may be considered a special case. Let equation (2) represent the demand equation.

---

[16] In dynamics, eqilibrium consumption is defined as the asymptotic limit of actual consumption. For exactness, our argument should be stated: By period n actual consumption is so close to equilibrium consumption that the difference $q_n - \bar{q}_n$ is negligible and little error is introduced by assuming them to be equal.

It was previously implied that the long run is the total time required for consumers to completely adjust their consumption behavior to changes in price. In order to obtain estimates of long-run elasticity, equilibrium must be approached and hence the series of coefficients relating to the $n+1$ prices must converge to zero. That is, the effect of the change in price is expected to decrease as the time of the change recedes further into the past. As an approximation of this restriction placed upon the series of coefficients, assume that the coefficients associated with the lagged values of price follow the arithmetic progression,

$$a_i = a_1 + (i-1)k = a_{i-1} + k; \quad i = 2, \cdots, n; \tag{8}$$

where a_1 and k are of opposite sign. Further assume that n and k are finite. At the position of equilibrium the series of coefficients must approach zero, so that

$$a_{n+1} = a_1 + nk = 0. \tag{9}$$

From (9) if equilibrium is approached in line with the specified approximations, we would expect $a_1 = -nk$, which can be tested statistically.

Upon substituting assumption (8) into equation (2) we obtain

$$\begin{aligned} q_t = a + a_0p_t + a_1p_{t-1} + (a_1 + k)p_{t-2} + (a_1 + 2k)p_{t-3} \\ + \cdots + [a_1 + (n-1)k]p_{t-n} \end{aligned} \tag{10.a}$$

$$q_t = a + a_0p_t + a_1 \sum_{i=1}^{n} p_{t-i} + k \sum_{i=2}^{n} (i-1)p_{t-i} \tag{10.b}$$

The second and third price terms are, respectively, simple and weighted sums of price. They can be converted to simple and weighted averages by dividing by n and $\sum(i-1)$. To preserve the equality, the respective coefficients must then be multiplied by these same terms.

$$q_t = a + a_0p_t + na_1 \frac{\sum_{i=1}^{n} p_{t-i}}{n} + k \sum_{i=2}^{n} (i-1) \frac{\sum_{i=2}^{n} (i-1)p_{t-i}}{\sum_{i=2}^{n} (i-1)} \tag{10.c}$$

$$q_t = a + a_0p_t + a_1^*p_{at} + k^*p_{wt}, \tag{10.d}$$

where p_{at} and p_{wt} are, respectively, simple and weighted averages of past prices.

The short-run price elasticity is a_0; the long-run price elasticity is

$$\sum_{i=1}^{n} a_i = a_0 + na_1 + k \sum_{i=2}^{n} (i-1) = a_0 + a_1^* + k^*. \quad i = 2, \cdots, n \tag{11}$$

The introduction of assumption (8) into demand equation (2) reduces the

estimation job considerably. Since all of the data needed to obtain estimates of the long-run elasticity are contained in equation (10.d) the problem is greatly simplified.

Let us now consider the case where consumption is specified as a function of current and past values of price and income. Assume that the demand equation is represented by the logarithmic linear equation

$$q_t = a + a_0 p_t + a_1 p_{t-1} + \cdots + a_n p_{t-n} + b_0 y_t + b_1 y_{t-1} + \cdots + b_m y_{t-m}, \tag{12}$$

where y_t represents the log of income. Demand equation (12) postulates that the consumers' reactions to changes in price and income are spread over $n+1$ and $m+1$ time periods respectively. Assume that each of the series of coefficients a_i and b_j follow the arithmetic progressions

$$a_i = a_1 + (i - 1)k; \qquad i = 2, \cdots, n \tag{13}$$

$$b_j = b_1 + (j - 1)h; \qquad j = 2, \cdots, m \tag{14}$$

where n and m may or may not be equal and are finite.

By substituting assumptions (13) and (14) into equation (12), one derives

$$q_t = a + a_0 p_t + a_1^* p_{at} + k^* p_{wt} + b_0 y_t + b_1^* y_{at} + h^* y_{wt} \tag{15}$$

in which

$$b_1^* = m b_1, \; h^* = h \sum_{j=2}^{m} (j - 1),$$

and where y_{at} is a simple average and y_{wt} is a weighted average of income over the past m years.

The short-run elasticity estimates are a_0 and b_0. The long-run elasticity estimates are (11) and

$$\begin{aligned} \sum_{j=1}^{m} b_j &= b_0 + m b_1 + h \sum_{j=2}^{m} (j - 1); \\ &= b_0 + b_1^* + h^*. \end{aligned} \tag{16}$$

Working Procedure

Assume $k=h=0$ in (13) and (14); then $a_1 = a_2 = \cdots = a_n$ and $b_1 = b_2 = \cdots = b_m$ and equation (15) becomes

$$q_t = a + a_0 p_t + a_1^* p_{at} + b_0 y_t + b_1^* y_{at}. \tag{17}$$

The short-run price and income elasticities are, respectively, a_0 and b_0; the long-run elasticities are $a_0 + a_1^*$ and $b_0 + b_1^*$.

This same procedure can be used to derive the equation used by Working

if the hypothesized demand equation is

$$p_t = c + c_0 q_t + c_1 q_{t-1} + \cdots + c_n q_{t-n}. \tag{18}$$

Assuming $c_i = c_{i-1} + k$, $i = 2, \cdots, n$ yields

$$p_t = c + c_0 q_t + c_1^* q_{at} + k^* q_{wt}. \tag{19}$$

Working implicitly assumes $k = 0$. This gives

$$p_t = c + c_0 q_t + c_1^* q_{at}. \tag{20}$$

He performs an algebraic transformation and estimates

$$p_t = c + c_0 (q_t - q_{rt}) + (c_0 + c_1^*) q_{at}. \tag{21}$$

The short-run price flexibility is c_0; the long-run price flexibility in (20) is $c_0 + c_1^*$, in (19) it is $c_0 + c_1^* + k^*$.

Thus it is seen that the basic assumptions underlying Working's argument are: (1) Consumers' demand equation is (18). (2) After a price change, consumers achieve the new equilibrium in a finite number, n, of time periods. (3) The value occurring n time periods ago has the same effect on current behavior as the values occurring with shorter time lags, and all values with lags exceeding n have no effect on current behavior.

Empirical Results

Model

This section presents some estimates of price and income elasticities of demand estimated from equations (15) and (17) and compares them with results obtained by Working. It was decided to consider the meat sector since Working dealt with meat.

- q_t is the logarithm of per capita meat consumption during time period t
- p_t is the logarithm of average retail meat prices, in money of 1935–39 purchasing power, for time period t
- p_{at} is the simple average of the logarithms of lagged retail meat prices, in money of 1935–39 purchasing power, for n time periods previous to time period t
- p_{wt} is the weighted average of the logarithms of lagged retail meat prices, in money of 1935–39 purchasing power, for n time periods previous to time period t
- y_t is the logarithm of per capita disposable personal income, in money of 1935–39 purchasing power, for time period t
- y_{at} is the simple average of the logarithms of lagged per capita disposable personal income, in money of 1935–39 purchasing power, for m periods previous to period t
- y_{wt} is the weighted average of the logarithms of lagged per capita disposable personal income, in money of 1935–39 purchasing power, for m time periods previous to period t

x_t is the logarithm of meat marketing charges, in money of 1935–39 purchasing power, for time period t
u_{1t} is the residual error of the demand equation
u_{2t} is the residual error of the supply equation

The supply equation for meat at retail is

$$q_t = c + c_0p_t + c_1x_t + u_{2t} \tag{21}$$

Altogether six different models were used: three including (15) as the demand equation and assuming n=m=3, 5 and 9, respectively; and three including (17) as the demand equation and again assuming n=m=3, 5 and 9. The variables q_t and p_t are considered to be endogenous and the variables p_{at}, p_{wt}, y_t, y_{at}, y_{wt} and x_t are treated as predetermined or exogenous.

Data

The estimates are based upon annual data for the sample period 1922–41. Data relating to the consumption and retail price variables were obtained from appendix A of Working's study. To represent the meat marketing cost variable x_t, the Agricultural Marketing Service (AMS) series of farm-retail price spread for choice grade beef, pork and lamb cuts were deflated by the cost of living index. The series of per capita disposable personal income, of the AMS and the Department of Commerce, was put on a 1935–39=100 base, deflated by the cost of living index and used in constructing the variables y_t, y_{at}, and y_{wt}. The variables were measured in terms of logarithms so that the elasticities could be obtained directly from the coefficients.

Comparative Results

Estimates of the coefficients in equations (15) and (17) are presented in Table 1.[17] All of the point estimates of the coefficients of current price and current income have the expected sign and are significantly different from zero at the 10 per cent or a higher probability level. None of the coefficients of the simple or weighted averages are significant. Nevertheless, for illustrative purposes long-run elasticities were estimated and are shown in Table 2, along with some results obtained by Working.

Table 1 shows quite clearly the effect that intercorrelation among independent variables has on standard errors. The variables p_{at} and p_{wt} are highly correlated, as are y_{at} and y_{wt}. With one exception, the standard errors in equation (17) are smaller than the corresponding standard errors in (15). In both forms of the demand equation, R^2 rises as n rises. Varying n and m causes sizeable variations in the estimated coefficients.

[17] The estimates were obtained by the Theil-Basmann method. See R. L. Basmann, "A Generalized Classical Method of Linear Estimation of Coefficients in a Structural Equation," *Econometrica*, January, 1957, pp. 77–83. T. D. Wallace and G. G. Judge, *Discussion of the Theil-Basmann Method for Estimating Equations in a Simultaneous System*, Oklahoma Agricultural Experiment Station. Processed Series P-301, 1958.

TABLE 1. ESTIMATES FOR THE WORKING AND GENERALIZED WORKING DEMAND EQUATIONS FOR MEAT

Value of n (=m)	Estimates of Coefficients[a] a_0	a_1*	k*	b_0	b_1*	h*	a	R^2	d[b]
Demand equation (17):									
3	−0.704*** (0.182)	−0.092 (0.188)		0.571*** (0.153)	−0.032 (0.198)		2.107	0.545	1.867**
5	−0.745*** (0.186)	−0.088 (0.240)		0.584*** (0.147)	−0.122 (0.212)		2.307	0.581	1.874**
9	−0.874** (0.324)	0.557 (0.486)		0.613*** (0.162)	−0.193 (0.532)		1.708	0.685	2.229**
Demand equation (15):									
3	−0.796** (0.329)	0.131 (0.568)	−0.213 (0.501)	0.604** (0.204)	−0.089 (0.468)	0.055 (0.388)	2.156	0.581	1.899†
5	−0.674** (0.300)	−0.254 (0.499)	0.193 (0.528)	0.526** (0.232)	0.062 (0.588)	−0.168 (0.516)	2.263	0.643	1.946†
9	−0.515** (0.239)	0.102 (0.633)	0.550 (0.493)	0.450* (0.226)	0.433 (0.643)	−0.319 (0.665)	0.823	0.709	2.468†

[a] Coefficients on top line; standard errors underneath in parentheses. Where the coefficients are significantly different from zero, the level of significance is indicated by superscripts as follows; * significant at 10 per cent level of probability, ** significant at 5 per cent level and *** significant at 1 per cent level.

[b] When d is significant at a 5 per cent probability level it is indicated by a **superscript, whereas when the test of d is inconclusive it is indicated by a † superscript.

TABLE 2. ESTIMATES OF THE ELASTICITIES OF DEMAND

A. From Equations (15) and (17)

Value of n (=m)	Price		Income	
	Equation (17)	Equation (15)	Equation (17)	Equation (15)
Short-run elasticities				
3	−0.704	−0.796	0.571	0.604
5	−0.745	−0.674	0.584	0.526
9	−0.874	−0.515	0.613	0.450
Long-run elasticities				
3	−0.796	−0.878	0.539	0.569
5	−0.833	−0.736	0.462	0.419
9	−0.317	0.137	0.419	0.564

B. Obtained by Working[a]

Value of n	Price	
	Short-run	Long-run
5	−0.782	−0.988
10	−0.776	−1.220

[a] Source: *Demand for Meat* Chicago: University of Chicago Press, 1954, pp. 48 and 51. (Sets 7a and 8a)

Table 2 shows several instances in which a short-run elasticity exceeds a comparable long-run elasticity. A short-run elasticity significantly greater than a corresponding long-run elasticity represents a situation in which consumer's initial reaction to a change is to over-adjust. Such a situation would be depicted in Figure 1 by drawing the dotted line q_t so that it fell below $\bar{q}$ at time 0 and then approached $\bar{q}$ as time progressed.

Since the coefficients a_1^*, k^*, b_1^*, and h^* do not differ significantly from zero, we would conclude that the short-run and the long-run elasticities of demand for total meat are not significantly different on an annual basis. This means that lines q_t and $\bar{q}$ in Figure 1 are identical. This contrasts with Working's finding that the long-run price elasticity exceeds the short-run price elasticity.

It was pointed out earlier that the generalized Working procedure imposes on the coefficients the *a priori* restrictions $a_1+nk=0$ and $b_1+mh=0$. Because of the nonsignificance of the coefficients associated with the aver-

TABLE 3. ESTIMATED VALUES OF THE ARITHMETIC PROGRESSION TERMS ASSUMED IN THE GENERALIZED WORKING EQUATION

Value of n (=m)	Price			Income		
	a_1	k	a_1+nk	b_1	h	b_1+mh
3	0.044	−0.071	−0.169	−0.030	0.018	0.024
5	−0.051	0.019	0.044	0.012	−0.017	−0.073
9	0.011	0.015	0.146	0.048	−0.009	−0.033

ages we did not run statistical tests of these restrictions; however, Table 3 shows the sums and their components.

The generalized Working method has the one logical advantage over the Working method: It does not make the special assumptions of the latter method. It can, therefore, be used to test statistically the Working hypotheses that $k=0$ and $h=0$. Because of the existence of high intercorrelation among independent variables, these null hypotheses will probably often be accepted.

LAND VALUES AS MEASURES OF PRIMARY IRRIGATION BENEFITS*

J. W. MILLIMAN**
University of California, Los Angeles

EVALUATION of existing and proposed irrigation projects requires estimation of benefits and costs in present value terms. Recently a number of studies have appeared which deal with the efficacy of techniques used by federal agencies in project evaluation.[1] It is apparent that current policies and techniques for project planning and valuation can be improved. Among the suggestions for improvement in the techniques of evaluation is the proposal by Edward F. Renshaw to use changes in the values of agricultural lands as indirect or proxy measures of the primary benefits of irrigation projects.[2] It is the purpose of this paper to explore some of the implications involved in the use of changes in land values as measures of primary benefits stemming from irrigation investment.[3] It is hoped that the analysis here will serve to stimulate further investigation of the relation between land values and irrigation benefits.

Measurement of Primary Benefits

The "Green Book" states that:

> *Primary benefits* are the value of the immediate products or services resulting from the measures for which the project costs and associated costs were incurred.[4]

There seems to be general agreement that the primary benefit from any project can be viewed as the worth or value of the output of the project to

* Giannini Foundation Paper No. 175.

** The author has benefited from criticism by J. DeHaven, J. Hirshleifer, and R. McKean.

[1] Roland N. McKean, *Efficiency in Government through Systems Analysis,* New York: John Wiley & Sons, 1958; Edward F. Renshaw, *Toward Responsible Government,* Chicago: Idyia Press, 1957; Otto Eckstein, *Water Resource Development,* Cambridge: Harvard University Press, 1958; John Krutilla and Otto Eckstein, *Multiple Purpose River Development,* Baltimore: John Hopkins Press, 1958.

[2] Renshaw, *op. cit.,* Chapter VII. See also "Cross-Sectional Pricing in the Market for Irrigated Land," *Agricultural Economics Research,* January, 1958, pp. 14-19; and "An Economic Appraisal of Public Investment in Irrigation," Ph.D. dissertation, University of Chicago, 1957, Chapter VI.

[3] It is important to note that estimation of primary benefits stemming from an irrigation project is only part of the evaluation problem. This paper does not deal with questions involving secondary benefits or "extra-market" benefits. Furthermore, it is concerned only with benefits *per se* and not with benefits in excess of or in relation to costs.

[4] *Proposed Practices for Economic Analysis of River Basin Projects,* report to the Federal Inter-Agency River Basin Committee, prepared by the sub-committee on Benefits and Costs, May, 1950, p. 8.

those who use it. Conceptually, this means that the direct measure of the primary benefits can be found by summating or aggregating the maximum prices which the consumer would pay for the various units of output from the project.[5] For an irrigation project, the primary benefits are equal to the economic worth of the water to the farmer.[6]

According to this analysis the primary benefits of an irrigation investment could be estimated from the demand curve for the water from the project. To illustrate the nature of the argument, reference is made to Figure I.

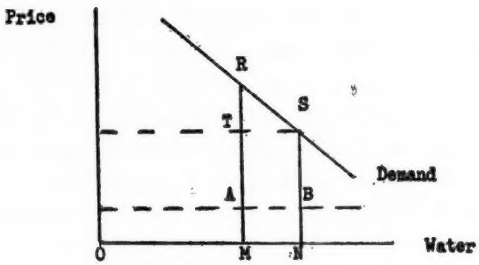

FIG. I

If a project were constructed to supply MN units of irrigation water, the primary benefit of the project would be the value of the water or MRSN[7] The present value of the benefit stream could be obtained by the summation of the areas under the demand curve for each time period, discounted by the appropriate rate of interest.

If the demand function for the irrigation water were known, it would be possible to estimate directly the primary benefits stemming from irrigation investment. The difficulty of the matter is that relatively little work has been done on the estimation of the demand function for irrigation water. This deficiency stems in part from the nature and history of econometric studies in agriculture which have concentrated almost exclusively upon the markets for farm products and have neglected the supply and demand elasticities of the various input factors on the production side of agriculture.[8]

[5] McKean, *op. cit.*, Chapter 10.

[6] This assumes that the irrigation project is a single-purpose project, i.e., only a supplier of water. The consideration of multi-purpose projects would not change the nature of the argument here because we are concerned only with benefits resulting from irrigation. And also the same logic could be used in the analysis of benefits of each of the outputs of a multi-purpose project.

[7] It is assumed here that the demand function illustrated by RS connects the maximum prices farmers would be willing to pay for output MN.

[8] Zvi Griliches, "The Demand for Fertilizer: An Economic Interpretation of a Technical Change," *Journal of Farm Economics*, August, 1958, p. 591.

Another part of the difficulty arises because of the peculiar nature of the market for water in which the pricing system is relegated to a minor role in the allocation process. Most factor inputs in agricultural production are allocated by the price mechanism, in that prices are allowed to clear the market and to equate supply and demand. For various reasons irrigation water, particularly in the West, is often allocated by means other than the price mechanism, so that prices for the water are often "nominal" prices which are less than those which would prevail under free-market conditions.[9] This means that rationing and quotas are common in the allocation of irrigation water.

Neither of the reasons for the apparent lack of attention given to the demand function for irrigation water appears to involve severe conceptual problems, so it may be possible to make greater use of direct estimation of the economic worth of the water in the future. Presently, the estimation of primary irrigation benefits is accomplished through the use of indirect measures. The most widely used procedure and the one which is currently used by all federal agencies who deal with irrigation water is the "budget" method.

The "budget" method involves the estimation of primary benefits of water by making assumptions as to the crops to be produced on the land and the gross receipts arising from their sale. Then production expenses for farm operation and investment are subtracted from the value of farm products produced. The residual amount is considered equal to the primary benefits and thus the value of the water to the farmer. It is obvious that the "budget" method involves the use of a vast number of assumptions concerning crop yields, output prices, factor costs, and coefficients of production in all future years. The possibilities for errors in estimating and in double-counting are quite numerous.

Recently Renshaw, who was evidently stimulated by D. Gale Johnson's earlier concern with land values,[10] has developed some models based upon crop-value indexes to predict changes in land values resulting from irrigation projects. It is Renshaw's belief that a certain proportion of expected gross receipts are capitalized into land values so that land values can be estimated on the basis of gross farm income. The expected change

[9] Two important reasons are evident here. One is that water law in most states places a number of restrictions upon the transfer or exchange of water by market forces. See: J. W. Milliman, "The Case for Private Decision-Making in a System of Water Law," The RAND Corporation, P-1483-RC, September 4, 1958. Another important reason stems from the widespread feeling that irrigation water use has important "extra-market" benefits so that the price of water should be a secondary consideration in its use.

[10] D. Gale Johnson, "Allocation of Agricultural Income," *Journal of Farm Economics*, November, 1948, pp. 724-745.

in land values plus the present worth[11] (per acre) of the water payment contracts assessed against the land is a measure of the primary benefits of the irrigation project.

The advantages of the Renshaw approach, as compared to the budget method of estimating the primary benefits of irrigation investment, appear on first consideration to be quite substantial:

1) The number of variables to be estimated is substantially smaller and involves fewer assumptions and less information.
2) The market for land does the discounting so that there exists no problem of how to determine the "correct" rate of discount or how to treat future risk and uncertainty.
3) Double-counting and overestimation of benefits may be somewhat reduced.

On theoretical grounds, however, both methods are correct and each should lead to the same values if carried out in the proper manner.

Essentially Renshaw's suggestion involves two assumptions: First, that changes in land values "with" and "without" irrigation reflect a capitalization of expected net income resulting from the water; second, that a crop-value index can be used as a predictor of land values. With both of these assumptions, there is little with which to disagree. It is suggested, however, that study of the theoretical and empirical basis of these assumptions is called for. Renshaw does not offer much theoretical explanation of these assumptions nor does he follow through with a discussion of some of the implications involved, particularly in regard to the former.

With regard to the value of the crop-index method of predicting land values, Renshaw does give a partial evaluation which serves to point toward its chief merits and deficiencies:

> Essentially all that a crop-value index can do is to measure the effect on land value of substitutions to crops yielding higher opportunity returns per acre. It will be of little use as a predictor of land value if the real factors that affect land value either are not, or cannot easily be made, a function of cropping pattern by defining crops appropriately in such a way as to pick up differences in income-yielding potentiality.[12]

It is obvious that many important changes in the production function can not be reflected in any precise way in statistics on acreages devoted to the various crops. It is also clear that cropping patterns are only one of many forces which influence land values. The crop-value index may prove to be useful, however, and certainly it deserves extensive study and discussion.

---

[11] Renshaw used an interest rate of 4½ per cent, the farm mortgage rate for 1956, as the rate of discount.

[12] Renshaw, "Cross Sectional Pricing - - -." *op. cit.*, p. 19.

The first part of Renshaw's suggestion seems to be of primary importance. It is also the part to which he has given the least attention. The remaining part of this paper is concerned with an examination of the analytical basis for the premise that changes in agricultural land values can be used as indicators of the primary benefits resulting from the provision of irrigation water. What is the theoretical justification of this premise? What are some of the dangers and drawbacks in the use of land values as proxy measures of benefits of irrigation investment?

The Value of Water

If the value of water is to be reflected in land values, as Renshaw suggests, the relationship is probably very simple and direct. Any increase in land values resulting solely from the provision of additional irrigation water must represent a market capitalization of the expected future stream of value received from the water which is *in excess* of the charges for water paid by the farmer. That is to say, land values will increase only to the extent that the value or economic worth of the water exceeds the charges for the water. It follows, furthermore, that economic worth of the water (and thus the value of the new irrigation facilities) can be viewed as a summation in present value terms of two factors:

1) The actual or expected revenue stream of the project (the charges for water).
2) Changes in actual or expected value of the agricultural land served by the project (abstracting from other factors which affect land values).

Perhaps the nature of the reasoning here can best be explained by reference to Figure I. Earlier it was argued the economic value of MN units of water, or the primary benefit of project supplying this water, can be viewed as the area under the demand curve for the water or MRSN. The argument followed here would hold that, if the farmers were charged an amount equal to MRSN, land values would not increase because of the increment of water supplied. On the other hand, if the farmers were charged less than MRSN, a "surplus" would arise which would tend to be capitalized in higher land values. If the farmers were to receive the water "free," all of the value of the water would be reflected in increases in land values.

Going further, before examination is made of some of the implications of the relationship between the value of water and land values, it follows that, if a market for water is allowed to function, the market price for water will tend to be SN. And the total revenue for MN units of water would be MTSN. In this case water revenues would understate the total value of the water by TRS. The "surplus" (or TRS) would tend to be capitalized by the market and would appear as an increase in land values.

As a practical matter, it can be argued that the "surplus" rising in such cases is likely to be small in relation to the total demand for water, unless extremely large increments of water supply are considered, so that the market value of the water would be a substantial approximation of the full economic value of the water.

The more likely case is that only a nominal price would be charged for the irrigation water, e.g., BN, and the allocation of water would be determined by some sort of non-price rationing. In this instance, the total water revenue might be something like MABN, which would mean that a "surplus" of ARSB would accrue and be reflected in substantial increases in land values. The land value method of measuring irrigation benefits would appear to have most applicability in this case.

Assumptions and Problems

The preceeding argument was based upon the supposition that the economic worth of an increment of irrigation water would affect land values only to the extent that the charges for water understated the value of the water. Perhaps it will be useful to examine the assumptions and implications of this argument.

First of all, it is clear that the analysis assumes that agricultural land is a fixed factor and also that it is the only fixed factor. This means that either agricultural uses are the only uses of the land or else that the value of the land in alternative uses is substantially less than its worth in agriculture, so that the "surpluses" appear as capitalized economic rent. If other fixed factors are present, e.g., certain capital equipment, any "surplus" arising from the purchase and use of irrigation water may conceivably be reflected in their values. There is no *a priori* reason why the "surplus" from water must go to land. In these cases increases in land values would understate the economic value of the water.

It might be pointed out in this connection that it may be difficult to show that the nonagricultural uses of land are unimportant. To the extent that land devoted to agriculture is merely an "inexpensive" way of reserving land for future residential (or other) uses on the basis of speculative judgment, it is not evident to what degree changes in agricultural land values would be due solely to the provision of extra irrigation water. This point is part of the general empirical problem discussed below of trying to abstract from changes in land values due to factors other than irrigation water.

Another problem needs to be mentioned here because it involves a relationship which is often overlooked. This is the point that any "surplus" value arising from the purchase of water by the farmer will tend to be capitalized in land values *only* to the extent that the land (or land owner) has some permanent claim to the water. If the water could be withdrawn

or denied to the land (e.g., an irrigation company might find a more profitable outlet for its water), it would be doubtful if the "surplus" would be capitalized in land values. The market value of agricultural land will undoubtedly reflect any uncertainty in the prospective provision of the irrigation water to the land. This means that increases in land values will be a full measure of the "surplus" only if the water is "frozen" to the land. It is thus quite possible that there may be cases where increases in land values would be less than the economic value of the water because of some uncertainty in regard to the future receipt of water.

A more troublesome problem may exist in the fact that the Renshaw analysis is based upon the premise that the major source of "surplus," i.e., economic value in excess of charges, arises from the provision of water. To the extent that the extra production arising from the increment of irrigation water involves increased amounts of other inputs, it is quite conceivable that some "surplus" may arise from their use and be reflected in land values. In this case (which seems realistic) it can be argued that increases in land values overstate the value of the water.

There are two lines of comment which can be made in response to this objection, although it is not clear that either reply really disposes of the problem. One might argue, for example, that the water, i.e., the irrigation project, is the essential "pre-condition" for the increased production and therefore *all* of the increase in land values is *really* due to the irrigation project, despite the fact that "surplus" may accrue to farmer from the purchase of other inputs and from other concurrent or concomitant investment related to farm production. It does not seem that this reply is a valid one. If "surpluses" do arise from other inputs and investments, it is only a semantic argument to resort to the idea of "primary causation" and to attribute all of the surplus to water.

A second line of argument might concede the presence of the problem in a theoretical sense, but deny its practical relevance. It might be argued, for example, that producer surplus arising from the purchase and use of other inputs would likely be negligible because the market prices would closely approximate their economic worth, leaving little surplus to be capitalized in land values. If, however, some of the inputs or collateral services represent a substantial increase in supply, e.g., a new processing plant, there may arise considerable surplus. This is the question which would have to be determined by direct investigation. A similiar source of extra surplus might be found where there is provision of added services by public units, particularly those which are supplied at "nominal" prices, eg., "free" highway services. In all of these cases it is very possible that increases in land values would overstate the value of the irrigation project.

At this stage of the analysis, it might be pointed out by some readers

that increases in land values might well involve some double counting or the inclusion of values of the secondary benefit variety. For example, it could be asserted that land values might increase in a nearby town because of the actual or expected increase in business activity resulting from the increase in agricultural production arising from the new irrigation investment.

This paper is concerned only with the attempt to measure primary benefits. It should be understood, therefore, that the argument here applies *only* to changes in the value of agricultural lands and not to changes in the market values of residential land, or other types of property. Increases in property values of adjacent residential lands might be an alternative measure of secondary benefits, however, in the same sense that changes in the values of agricultural lands would reflect primary benefits. On this score it could be pointed out that measurement of secondary benefits by use of changes in land values might be even more difficult than measurement of primary benefits.

For purposes of making an *ex post* appraisal or audit of irrigation projects, using the land value concept, it would seem important that the observer abstract from changes in land values due to factors other than the provision of extra water. This would be difficult when in cases where a number of incremental services are being provided simultaneously and especially if they are "free" to users. Other important changes in the institutional and economic environment within which agricultural production takes place, e.g., the soil bank proposal or changes in the quality of farm managament, would also have to be recognized. Changes in the general price level and in the level of interest rates would present additional problems.

It would also seem necessary that the actual and/or expected revenue stream arising from water charges be discounted at the same rate of interest which is implicit in changes in agricultural land value if the two values are to be summated as the theory suggests. Practical difficulties would be present also to the extent that information regarding land values was unreliable or nonexistent. Admittedly a good deal of arbitrariness would be involved in making estimates of general land values in agricultural areas involving wide variations in fertility, location, and climate. To the extent that agricultural land markets were "thin," i.e., few sales taking place, land values would be more difficult to estimate.

In *ex ante* project valuation, the use of land values as indicators of primary benefits would involve the problem of finding the market value of land that would be comparable in all other respects to the nonirrigated land except that it would have water available. If comparability could be assumed, the difference in land values, "with" and "without" water, would be a *partial* measure of the value of the proposed irrigation project in

present value terms. The difference in land values would measure the *entire* value of the water only if the water were "free," e.g., rainfall. To the extent that charges are made for water on the land used as a yardstick, the difference in land values would reflect only part of the value of water. It would be necessary to take into account both the capitalized value of these charges as well as the difference in land value in order to make the correct comparison.

The major problem in any *ex ante* valuation would be the degree of comparability of the two land situations. If one were to demand strict comparability, he would undoubtedly be disappointed. In an apparent effort to reduce the error here, Renshaw makes use of the crop-value index. Whether or not the crop-value index can be a better indicator of probable land values than going directly to the land market in an attempt to find comparable land "with" water is not clear.[13] The answer probably depends upon the particular circumstances in individual projects.

It would seem, however, that there might be cases where sufficient comparability is present (or where modifications can be made for obvious differences) so that direct reference to the land market could be used for the "with" and "without" comparison. A case in point may arise when the proposed irrigation investment is merely an extension of an existing project so that the new lands to be irrigated are quite similar in location, fertility, and climate to land already under cultivation. Certainly, the use of comparative land values for estimates of probable irrigation benefits would be feasible in cases where quick and rough estimates need to be made so that exact comparability between two land situations would not be required. It is also possible that comparative land values could be used as a check upon estimated primary benefits of irrigation investment derived by either the budget method or crop-index methods of valuation.

Conclusion

The primary benefits arising from an irrigation project can be viewed as the economic worth of the water to the prospective irrigators. Attempts to measure the value of the water directly are hampered by the lack of data concerning the demand function for water and by the fact that the water is often allocated by means other than the market mechanism. As a result indirect measures of the value of the water are used. The most widely used method is one which makes a "budget" study of expected net returns from the land. The necessity of making a number of "heroic"

[13] A promising method of comparing widely separated lands for agricultural purposes has been suggested by Thornthwaite and is based upon the concept of "potential evapo-transpiration." See his: "Evapotranspiration in the Hydrologic Cycle," *The Physical Basis of Water Supply and Its Principal Uses,* Vol. II. Interior and Insular Affairs Committee, House of Representatives, U.S. Congress, 1952, pp. 25-41.

assumptions concerning future yields, costs, receipts, and production coefficients makes this method cumbersome and unreliable.

Recently, Renshaw has suggested that changes in land values could be used as indirect measures of irrigation benefits. It was claimed that this method offers a great deal of promise because it relies upon fewer assumptions and reduces the possibility of over-counting.

The analysis in this paper indicates that the case for the use of land values as opposed to the "budget" method of measuring primary irrigation benefits may not be as promising as Renshaw suggests. Indeed, the land value method seems to involve an equal number of theoretical and empirical problems which are not easily resolved. It is probably fair to say that both methods require use of "heroic" assumptions. The better method will depend upon the particular circumstances which stem from individual project evaluation problems.

NOTES

A MISTAKE IN PROBLEM FORMULATION AND ITS IMPACT ON FARM POLICY

WALTER W. WILCOX
Library of Congress

SOMETHING has gone wrong. According to the accepted doctrine in agricultural economics, high-level industrial employment, low-level farm price supports and increased mobility of farm people should solve the price and income problems in agriculture.[1]

We have had high-level industrial employment for some time, farm people have left the farms in record numbers for several years, we have lowered farm price supports and expect to lower them still further, yet farm program costs have set new records while farm income has fallen sharply.

Even more disconcerting, under the new legislation passed in 1958 it is probable that farm program costs and farm surpluses will set new records, yet farm income, which showed temporary improvement in 1958, will continue its 1952 to 1957 decline.

Agricultural economists, though armed with more fully developed theory and new precision tools for measurement thus far have failed to agree on a new diagnosis or on alternative proposals for dealing with the problem.

Lack of professional training and experience in dealing with the dynamics of technological innovation in agriculture is probably the single most important reason for the continued failure of many agricultural economists to appraise correctly the causal factors in the "current farm problem." The hopes for an indefinite expansion in the demand for farm products also have not been subjected to a critical reappraisal. As students and as teachers we have given too little time to the study of the functioning of the agricultural economy under conditions of rapid technological advance and to the integration and interpretation of recent empirical studies.

These recent studies indicate (to the writer) something of what was wrong with the earlier diagnosis. The problem is not primarily one of re-establishing equilibrium relationships which had been disturbed by wartime forces and by short-sighted farm price support programs. Rather, these recent empirical studies as reported in the papers submitted by panelists appearing before the Joint Economic Committee in December

[1] See, for example, *Turning the Searchlight on Farm Policy*, Chicago, The Farm Foundation, 1952.

1957,[2] indicate that the price and income problem, basically grows out of the excessive rate of technological advance in agriculture, in relation to market expansion potentials.[3]

The critical elements of the current problem as indicated by these studies follow:

1. The aggregate domestic demand for food is highly inelastic (about −0.2 at the retail level) and the aggregate demand for total farm output also is highly inelastic, probably −0.4 or lower at the farm level.
2. Other groups in our economy who manufacture and sell the supplies purchased by farmers, and those who process and market farm products have various degrees of market power. In the absence of marketing agreements and farm price supports the 2,200,000 commercial farmers have none.[4]
3. Improved technology via atomistic competition in agriculture is increasing the supply of farm products from year to year at a rate about twice as fast as the demand for food and fiber is expanding as a result of increases in the population and in real income per capita.

   This rate of increase in output is largely the result of our excellent research and educational programs for farmers and is only slightly affected by substantial variations in the farm price level. Detailed analyses indicate this high rate of technological advance may continue and perhaps accelerate for a number of years.
4. With atomistic competition prevailing in agriculture it is profitable for individual farms to adopt new technologies even though farm prices are falling. Competitive forces lead to the more general adoption of these technological advances even though the increased aggregate output results in a sharp decrease in aggregate income.

   Fully as important, most of the resources previously committed to agriculture—tractors, improvements in land, harvesting machinery and much of the previously committed labor—cannot shift to alternative employment—hence these resources continue to be used in agricultural production throughout their productive life in spite of low returns from their use. Under these conditions insights obtained from the usual partial-equilibrium analyses, assuming tech-

---

[2] Joint Economic Committee Print. *Policy for Commercial Agriculture,* Government Printing Office, November 22, 1957. Reviewed in the August 1958 issue of this Journal.

[3] See also Willard W. Cochrane, *Farm Prices—Myth or Reality,* University of Minnesota Press, 1958.

[4] See Robert L. Clodius, *Opportunities and Limitations in Improving the Bargaining Power of Farmers,* one of a group of papers on the current farm problem to be published by Iowa State College, Center for Agricultural Adjustment.

nology constant, are both irrelevant and dangerous. In the past they have acted as opiates, dulling our perception of the lack of a socially tolerable economic equilibrating mechanism for the introduction of new technologies in the agricultural industry, faced as it is with a highly inelastic demand for its product.[5]

5. Given the magnitude of the maladjustment between aggregate output and aggregate demand at stable price levels at the present time (output being 5 to 8 per cent excessive) and given the economy of substituting other resources for labor as reported by recent studies—farm consolidation and the migration of labor out of agriculture, now occurring at the rate of 1 to 2 per cent a year, could double or perhaps triple without slowing down the rate of increase of aggregate output.

   If commercial marketings were increased 5 to 8 per cent, farm prices would drop sharply, perhaps 15 to 35 per cent and, since production expenses now absorb about two-thirds of gross farm income, net farm income would drop even further. Also, in spite of farm consolidations at the highest rates possible, there would be more than 1,000,000 commercial farms remaining for many years and atomistic competition would still prevail. In view of the known new technologies in the testing stage and in the process of adoption, unless remedial action is taken, the outlook for future farm income is even darker—with its adverse effects both on farmers and on other sectors of the economy.

Agricultural economists play a large role in furnishing intellectual leadership on farm policy. The question now raised, however, is whether the profession, through mistakes in problem formulation, has not tended to confuse, rather than clarify, the basic policy issues.

More specifically, professional attention in the policy field has been centered overwhelmingly on the freeing of prices to permit them to allocate resources more efficiently within agriculture on the assumption that the agricultural industry as a whole was moving more or less continually and smoothly toward an equilibrium position in relation to the balance of the economy where resources in the total economy are utilized with maximum efficiency. Farm leaders not trained in agricultural economics, with personal value systems acquired in an earlier period in their lives when the American economy more nearly approximated the classroom competitive model, were only too happy to be told that a rapidly expand-

[5] More empirical research is urgently needed to obtain additional insights regarding the effect of farm prices and income on the rate of adoption of new technology in agriculture. Undoubtedly the price and income effects on the rate of adoption vary depending on the particular new technologies in the process of adoption, the asset position of farmers and many other factors.

ing industrial economy and a return to freely competitive prices in agriculture would satisfactorily solve the price and income problem.

This widely accepted formulation of the basic problems of agricultural policy is sharply at variance with the findings of the recent empirical studies summarized in this paper. Agricultural economists, if they are to furnish the kind of intellectual leadership in farm policy urgently needed, must subject to critical re-examination some of their most widely and firmly held assumptions.

The profession has made considerable progress in improving its theoretical foundation and its tools for precision measurements. What is needed now is further improvement in problem formulation and a more general willingness to periodically re-examine and grapple with the dynamic problems growing out of the rapid adoption of new output increasing, cost reducing technologies in a competitive industry faced with a highly inelastic demand for its aggregate output. In this relatively unexplored area economists may not be able to make precise measurements but they may be able to formulate the important problems more realistically and provide increased understanding of the relevant facts and issues.

REFLECTIONS ON GROSS FARM OUTPUT

MARION CLAWSON
Resources for the Future, Inc.[*]

THE continuation of agricultural surpluses in the United States is perhaps the dominant fact upon the agricultural scene. Output has continuously outrun demand for the past three decades or more. Moreover, in only a few years of that span could it be contended that output was at its maximum, even in the short run. The consensus of informed agricultural experts is that surpluses on the present or larger scale will continue for two decades or longer.

Malthus would surely have found this an amazing situation! Thirty years ago, most agricultural economists, farm leaders, politicians, and members of the general public would have expressed disbelief that it would occur, especially if one had told them of the population upsurge of these same decades. Yet, here it is.

Demand for agricultural commodities has been subjected to intensive study for nearly four decades. In the early 1920's, some pioneering studies of demand were undertaken; and these have been continued, expanded,

[*] The views expressed herein are purely personal.

and made much more sophisticated with passing years. While no one would contend that we know everything about the demand for agricultural commodities in general or for specific commodities, yet the body of knowledge is impressive. By contrast, we know much less about the forces affecting agricultural output per commodity, per farm, and in total, short, medium, and long run.

The total forces affecting gross farm output are numerous and their interactions are complex. We have had a shifting input mix and a changing output mix, which pose difficult problems of measurement and of aggregation. But, in any account of the forces affecting gross farm output, changing technology is surely one major factor. We know all too little about how new technologies arise and are adopted by farmers. A reasonably comprehensive analysis of the forces affecting gross farm output, comparable to the many studies on demand for agricultural commodities, is a major research undertaking, perhaps beyond the scope of any single worker or group, no matter how talented.

Purpose of This Article

The purpose of this article is a comparatively modest one: to suggest that random annual variations in gross farm output, due primarily to weather conditions, have blurred the picture of a comparatively continuous and regular increase.[1] I hope that the simple analysis presented here will lead other researchers to examine this relationship more closely. It seems to me that the first step in any careful analysis of output, whether of total or by farms or by commodities, is to estimate first the effect of weather conditions in the year or other time period under study. When yields are unusually high, and total output correspondingly increased, this is largely, if not wholly, an unplanned increase—one not due to the decisions of the farmer and not due primarily to the input mix used, including the technology employed. Conversely, decreases in output are often unplanned. The effect of planned steps, whether in input mix or otherwise, can be estimated only when the effect of unplanned changes in output are eliminated. One might argue, of course, that such unplanned changes are too small in magnitude to matter, but this scarcely conforms to the facts. While they may be random in the statistical sense, yet their occurrence may coincide with certain planned changes, and the time period available for study in any case is relatively short.

[1] Since writing this article, my attention has been called to the doctoral dissertation of James L. Stallings, Michigan State University, 1958, entitled "Indexes of the Influence of Weather on Agricultural Output." Stallings is writing an article based on his dissertation, which it is to be hoped will shortly be published. His approach is more formal and more inclusive than mine; the results seem in general agreement.

Methods of Estimating Climatic Effects

Ideally, to remove the effect of weather deviations, one should have estimates for each crop each year. The total production of each crop under average weather, given the inputs, technology, and other factors which actually existed in that year, should be estimated. Presumably this could be done best region by region, or production area by production area. Certainly, the effect of different feed supplies upon livestock numbers and output should be estimated for that time period in which the different feed supplies would normally be used. If a clear relationship exists between prices and/or total return for a given crop and the acreage or other inputs in the following year, then the weather effects upon output in one year should be traced forward as far as their secondary effects would be significant.

In estimating the effects of weather upon crop output, one should consider all relevant weather factors. For a large part of the nation, total annual precipitation is often the dominant weather variable. But temperature, wind, hail, and other factors are also important, even in the dry regions and especially in the regions that normally get enough moisture. Timing of weather factors can be as important as amounts. Weather factors may either increase or decrease production of various crops; they may also affect inputs either by increasing them or decreasing them. When crops are a failure due to drouth, there is no need to expend money in their harvest for instance.

If one could accurately estimate the effects of weather each year, to the extent that weather deviated from average in each locality, then estimates of output, crop by crop, and in total, for average weather could be made. It is changes in this adjusted output which are presumably related to changes in decisions as to inputs, practices, and the like.

Method Used in This Paper

The present paper presents a simple short cut to the above procedure. It considers the year to year variations in crop yields per acre for three crops only—cotton, wheat, and corn. It is recognized that yields vary for many other crops as well. But these are three important crops, and their geographic distribution may make them useful indices of annual yield variations in other crops. Yield variations in wheat, for example, are closely related to total moisture conditions; so are yield variations of forage plants in the grazing regions. We attribute all year to year variations in crop yields, in comparison with trend or normal yields, to weather conditions. Strictly, this is not so. Part of the variation in annual crop yields, as well as the trend in yields, may be due to differences in rates of fertilizer inputs, to name but one example.

In recent years the trend in acre yields of these crops has clearly been upward. Our concern is with the annual fluctuations in yield, compared with trend yields. This requires that we estimate trends in yields, no easy task. It would obviously be a simple statistical problem to fit a straight line or any other predetermined equation to the available data on annual yields. But this does not really face the problem. In the period of statistically reliable data, we have had one series of massive drouths, those of the early 1930's. Experience in these years can dominate any formal statistical trend determination. If our experience record were long enough to cover several such drouths, presumably this would be no problem or a lesser problem. How we handled the trend-elimination problem will be discussed later.

Correction for year-to-year variations in crop yields omits consideration of the effect upon gross farm output of acreage of the various crops and of total crop acreage, of differences in crop inputs such as fertilizer, of differences in the degree of farm mechanization, and of differences in livestock numbers, feeding rates, and output. Included within "trend" is most or all technological changes such as different crop varieties, those changes in inputs which have a secular trend, such as amounts of fertilizer used, and various other forces, some unidentified. To the extent that any of these forces are mutually interrelated with crop yields due to weather conditions, it would be very difficult to eliminate their effects completely.

Crop Yields Since 1910

The basic data are in Table 1. Crop yields are on a harvested acre basis for cotton and corn; to the extent that there was serious crop failure or abandonment, variable from year to year, this omission causes crop yields to appear more stable than in fact they were. It excludes some of the adverse effects of weather. Crop yields for wheat were on a harvested acre basis up to 1918, since then are on a seeded acre basis. Since crop failure and abandonment are more common for wheat than for the other two crops, this is an important refinement in the data.

Per acre yields are plotted in Figure 1. The problem of estimating trend, about which to measure annual variations, is clear from this chart. I have assumed straight line trends in each instance. Cotton yields per acre were rather steadily and steeply downward from pre-World War I until the mid-1920's; this was primarily the effect of the spread of the boll weevil. Since then, they have been about equally steadily and steeply upward—due to the restriction of acreage to the better lands, the shift of acreage to the western irrigated lands where yields have always been higher, the increased use of fertilizer, better varieties, better control of

pests, and other factors. At what point did the downward trend give way to an upward one? I have chosen 1925, but the choice could well be shifted two or three years in either direction. It may be somewhat unrealistic to assume an abrupt shift from a downward to an upward trend; perhaps, more plausibly, there was a period of essentially neither upward nor downward trend, more or less across the 1920's.

Wheat yields were assumed to have neither upward nor downward trend in the early period for which data are available only on a harvest acre basis. A very slight upward trend from 1919 to 1932 seems evident; from then to the present, a greater one. For no other major crop are the deviations in acre yields as great or as persistent for several years as for wheat. In large part, this is because most wheat is grown in regions where total precipitation is the limiting factor, and where, at least over the period of historical record, there has been a strong tendency for high and low rainfall years to occur in "bunches."

Corn yields were assumed to have no downward trend until the late 1930's, then a strong upward trend. Had a straight line or any curve been fitted mathematically to the earlier record, it would have dipped downward a good deal by the mid-1930's. But our hypothesis is that this was due to unfavorable weather conditions. Since hybrid corn, which is one major factor for the upward trend in yields in recent years, was introduced before 1936, when we show the upward trend to begin, it might be argued that the upward trend actually began earlier and that the decrease due to unfavorable weather was even greater than we have shown.

The actual deviations in crop yields each year from these trends was calculated, first in bushels and pounds (not shown in Table 1), and then as percentages of the normal yields for that year. The deviations in percentage of normal for the three crops were averaged. Under any system of adjusting output to normal weather, some crops or some regions or a combination of both might be above average while others were below. In a large country, climatic differences, especially those of modest size, may not be all in one direction. Gross farm output was adjusted by an equal number of points in the opposite direction, as shown in Table 1. This assumes that if the average per acre yield of these three crops was 5 per cent above trend, that gross farm output was also 5 per cent above the level planned and the level which inputs, technology, and other factors would have produced if weather had been average.

Adjusted Index of Gross Farm Output

The result of this process, shown in the last column of Table 1 and in Figure 2, is a greatly smoothed series of data of gross farm output. The

TABLE 1. FARM OUTPUT, PARITY RATIO, PER ACRE YIELD OF IMPORTANT CROPS, PERCENTAGE DEVIATIONS IN CROP YIELDS FROM TRENDS, AND ADJUSTMENT OF INDEX OF FARM OUTPUT TO TREND YIELDS, 1910–1957

Year	Farm output (1910-14 = 100)[a]	Parity ratio[b]	Yield per acre: Cotton (pounds)[c]	Yield per acre: Wheat, all (bu.)[d]	Yield per acre: Corn (bushels)[e]	Percentage deviation, actual yield from trend yield[f]: Cotton	Percentage deviation: Wheat	Percentage deviation: Corn	Average	Index of farm output adjusted to trend yields[g]
1910	98	107	176	13.7	27.9	−14	− 4	+ 7	− 4	102
1911	94	96	215	12.4	24.4	+ 7	−13	− 6	− 4	98
1912	106	98	201	15.1	29.1	+ 2	+ 6	+12	+ 7	99
1913	96	101	192	14.4	22.7	− 1	+ 1	−13	− 4	100
1914	106	98	216	16.1	25.8	+14	+13	− 1	+ 9	97
1915	110	94	178	16.7	28.1	− 5	+18	+ 8	+ 7	103
1916	100	103	166	11.9	24.1	− 9	−16	− 7	−11	111
1917	105	120	167	13.2	26.2	− 7	− 7	+ 1	− 4	109
1918	106	119	164	14.8	23.9	− 7	+ 4	− 8	− 4	110
1919	106	110	166	12.3	27.3	− 3	0	+ 5	+ 1	105
1920	113	99	187	12.4	30.3	+11	0	+17	+ 9	104
1921	100	80	132	12.1	28.4	−20	− 2	+ 9	− 4	104
1922	100	87	149	12.6	27.0	− 7	+ 1	+ 4	− 1	101
1923	111	89	136	11.8	28.4	+13	− 6	+ 9	+ 5	106
1924	110	89	164	15.1	22.1	+ 6	+20	−15	+ 4	106
1925	113	95	174	10.8	27.6	+16	−14	+ 6	+ 3	110
1926	118	91	193	13.7	25.6	+24	+ 8	− 2	+10	108

[a] *Agricultural Outlook Charts, 1958*. Agricultural Marketing Service and Agricultural Research Service, USDA, November, 1957, p. 71.

[b] *Price Programs*, Agriculture Information Bulletin No. 135, January, 1955, USDA, p. 55; current issues of *Agricultural Prices*, Agricultural Marketing Service, USDA.

[c] Yields per harvested acre. Data for 1920–1956 from *Agricultural Outlook Charts 1957*, p. 79. Yield for 1957 estimated from data in Table 91, *Agricultural Outlook Charts 1958*.

[d] Yields per seeded acre, 1919–1956, and per harvested acre 1910–1918. Data for 1919–1957 from *Agricultural Outlook Charts 1958*, p. 92. Data for 1910–1918 from *Agricultural Statistics 1952*, USDA.

[e] Yields per harvested acre. Data from *Agricultural Statistics 1952* and *1955*, and current press releases.

[f] Trends in yields estimated as follows: Wheat yields on harvested acreage basis 1910–18, at 14.2 bushels per acre; on seeded acreage basis, 1919 at 12.3 bushels, 1932 at 13.0 bushels, 1956 at 16.0 bushels, and intermediate years on straight line interpolation; corn yields, 1910–36, at 26.0 bushels per acre; 1936 at 26.0 bushels, 1957 at 43.5 bushels, and intermediate years on straight line interpolation; cotton, 1910 at 205 pounds per acre, 1925 at 150 pounds, 1957 at 345 pounds, and straight line interpolations for intermediate years. Actual deviations calculated from trends, and converted to percentage of trend.

[g] Adjustment to equal amount but in opposite direction from average yield deviations.

at 12.3 bushels, 1932 at 13.0 bushels, 1956 at 16.0 bushels, and intermediate years on straight line interpolation; corn yields, 1910–36, at 26.0 bushels per acre; 1936 at 26.0 bushels, 1957 at 43.5 bushels, and intermediate years on straight line interpolation; cotton, 1910 at 205 pounds per acre, 1925 at 150 pounds, 1957 at 345 pounds, and straight line interpolations for intermediate years. Actual deviations calculated from trends, and converted to percentage of trend.

g Adjustment to equal amount but in opposite direction from average yield deviations.

TABLE 1 (*Continued*)

Year	Farm output (1910–14 =100)[a]	Parity ratio[b]	Yield per acre			Percentage deviation, actual yield from trend yield[f]			Average	Index of farm output adjusted to trend yields[g]
			Cotton (pounds)[c]	Wheat, all (bu.)[d]	Corn (bushels)[e]	Cotton	Wheat	Corn		
1927	116	88	162	13.3	26.6	0	+ 5	+ 2	+ 2	114
1928	121	91	163	12.9	26.6	− 3	+ 1	+ 2	0	121
1929	119	92	164	12.3	25.7	− 6	− 4	− 1	− 4	125
1930	116	83	157	13.1	20.5	−13	+ 2	−21	−11	127
1931	127	67	212	14.2	24.1	+14	+10	− 7	+ 9	118
1932	123	58	174	11.4	26.5	−10	−12	+ 2	− 7	130
1933	113	64	213	8.0	22.6	+ 7	−39	−13	−15	128
1934	96	75	172	8.2	15.7	−16	−38	−40	−31	127
1935	116	88	185	9.0	24.0	−12	−33	− 8	−18	134
1936	105	92	199	8.5	16.2	− 8	−37	−38	−28	133
1937	132	93	270	10.8	28.1	+21	−21	+ 5	+ 2	130
1938	127	78	236	11.6	27.7	+ 3	−16	0	− 4	131
1939	129	77	238	11.8	29.2	+ 1	−15	+ 2	− 4	133
1940	134	81	252	13.2	28.4	+ 4	− 6	− 3	− 2	136
1941	139	93	232	15.0	31.1	− 6	+ 6	+ 3	+ 1	138
1942	155	105	272	18.3	35.1	+ 7	+28	+13	+16	139
1943	152	113	254	15.1	32.2	− 2	+ 5	+ 1	+ 1	151
1944	156	108	299	16.0	32.8	+12	+10	0	+ 7	149
1945	155	109	254	16.0	32.7	− 7	+ 9	− 2	0	155
1946	158	113	236	16.1	36.7	−15	+ 9	+ 7	0	158
1947	153	115	267	17.4	28.4	− 6	+16	−19	− 3	156
1948	168	110	311	16.5	42.5	+ 7	+ 9	+18	+11	157
1949	163	100	282	13.1	37.8	− 5	−14	+ 3	− 5	168
1950	161	101	269	14.3	37.4	−11	− 7	− 1	− 6	167
1951	166	107	269	12.6	35.9	−13	−19	− 7	−13	179
1952	173	100	280	16.6	40.4	−11	+ 6	+ 3	− 1	174
1953	174	93	324	14.9	39.6	+ 1	− 5	− 1	− 2	176
1954	174	89	341	15.7	38.1	+ 4	− 1	− 7	− 1	175
1955	181	85	417	16.0	40.6	+25	0	− 3	+ 7	174
1956	182	82	407	16.4	45.4	+20	+ 2	+ 6	+ 9	173
1957	181	82	442	18.7	44	+28	+15	+ 1	+15	166

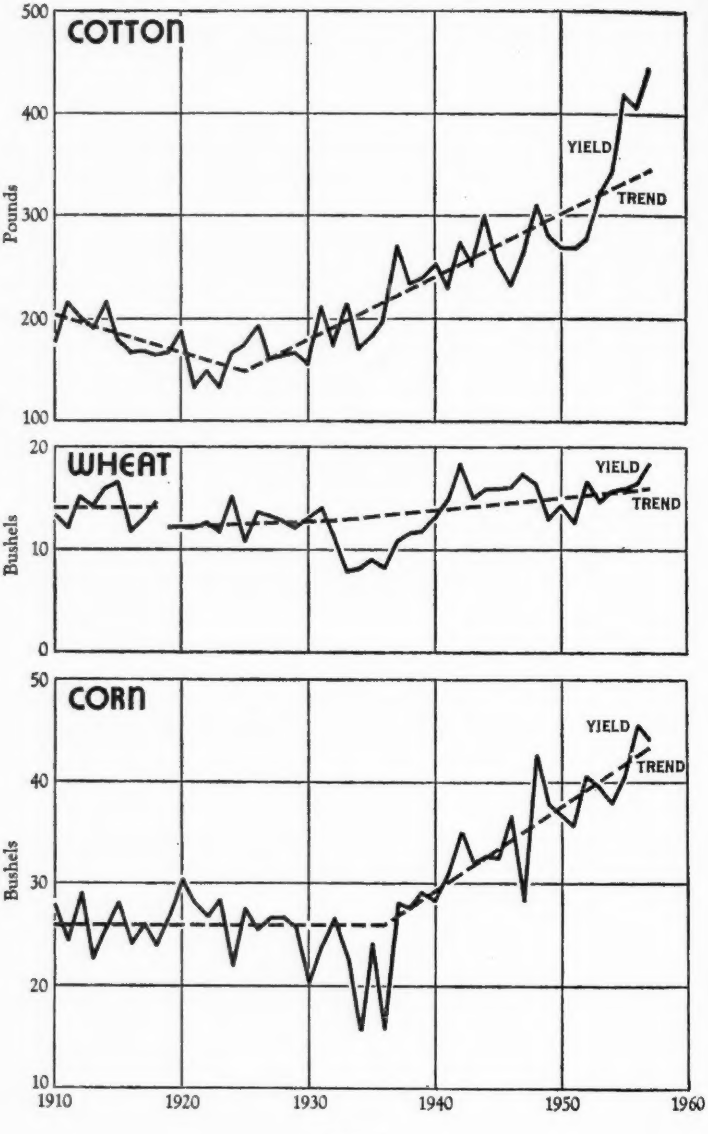

FIG. 1

magnitude of the change from year to year has been greatly reduced (Table 2). There are many fewer extreme changes, either decreases or increases, and many more relatively modest changes in either direction. Most strikingly, the effect of the massive drouths of the 1930's is virtually eliminated; the effect of the highly favorable weather years of the early 1940's

is toned down. As a result, the spectacular increase in total ouput of the early war years fades into only slightly more than an average increase.

This smoothed series exhibits a regular increase since about 1920, at very close to 1.65 per cent annually; for the entire period since 1910, the increase has been somewhat less regular but still relatively so, and at only a slightly lower rate of 1.40 per cent annually. We think it significant that these increases are regular on a logarithmic scale. Apparently it has been as easy to increase gross farm output 5 per cent when the index was 170 as when it was 100. If true, this is highly important for the future.

Though this process of adjustment for weather deviations produces a greatly smoothed series on gross farm output, there is still considerable variation in change from year to year. Presumably, it is these changes in gross farm output which were planned, and to which analysis of the decision-making processes should be directed. More detailed and refined methods of estimating weather effects might increase or reduce the adjustment for weather. On the basis used here, comparatively little effect of cyclical or other variations in cost-income ratios, such as the parity ratio, seems evident. The steady upward trend is presumably largely due to steady technological advances.

TABLE 2. CHANGES IN FARM OUTPUT, YEAR TO YEAR, 1910 TO 1957

Points Change, Year to Year	Original Data	Index Adjusted to Trend Yields of Major Crops
	Number of years	Number of years
Decline of 13 or more	2	0
Decline of 9 to 12	4	1
Decline of 5 to 8	3	3
Decline of 3 or 4	4	4
Decline of 1 or 2	6	12
No change	3	2
Increase of 1 or 2	4	11
Increase of 3 or 4	4	3
Increase of 5 to 8	9	7
Increase of 9 to 12	4	4
Increase of 13 or more	4	0
Total	47	47

The fact that farm output, adjusted for average weather, has increased so regularly at a rate of 1.65 per cent annually since 1920 is not proof that it will do so in the future, but it is at least suggestive. A variety of forces have been operative over the past, not with equal strength each year. Yet the rate of increase in output has been fairly regular. A variety of forces, including some different ones, will be operative in the future; but how much different will be their net effect? These are obviously impon-

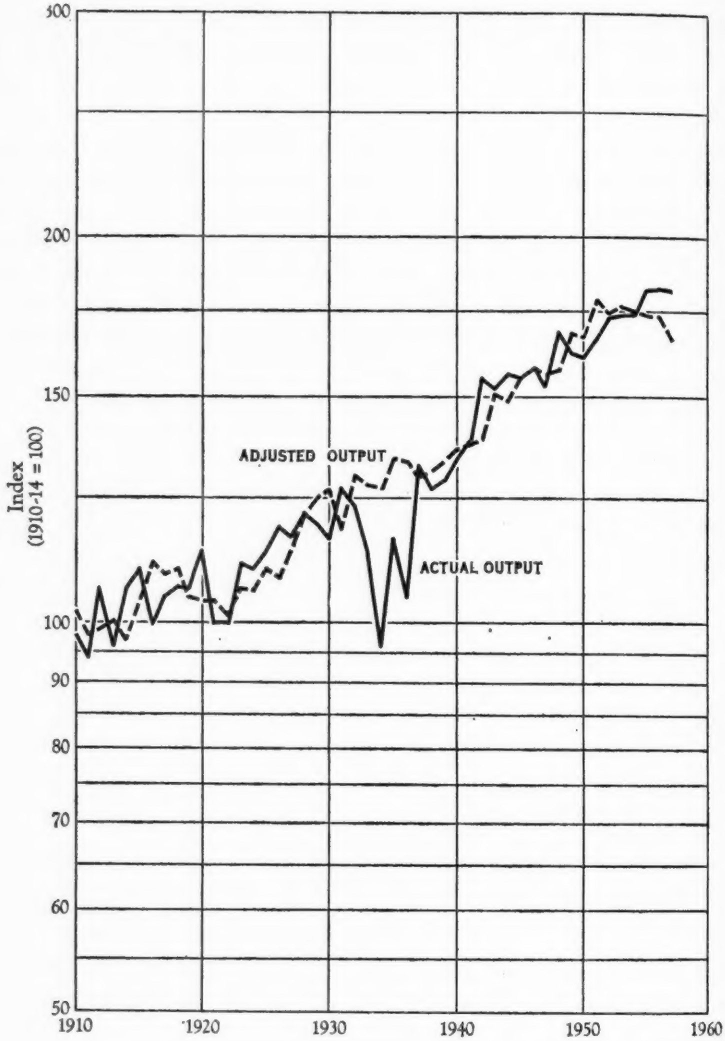

FIG. 2

derables, to a degree. Yet careful and detailed research may help to provide some answers. The thesis of this article has been that fruitful studies of gross farm output must consider first the effect of the unplanned and random forces of weather, in order more accurately to appraise the effect of planned actions.

THE OPTIMUM FODDER RESERVE–AN INVENTORY PROBLEM

WILFRED CANDLER
University of New England, Armidale, Australia

THE "inventory problem" was originally formulated as the problem of balancing the costs of additional inventories against the extra benefits gained from being able to satisfy an unknown future demand. This problem is characterized by the future demand being known only as a probability distribution.[1] An important agricultural example[2] of this problem concerns the optimum forage reserve for over-wintering stock, or for meeting recurrent disasters such as drought or flood.

The problem of drought is particularly important in Australia because such large areas are usually affected that there is little scope for shifting stock to unaffected areas. This article will start with a verbal description of the problem, which will be followed by an algebraic statement, and this in turn will be followed by a numerical example.

Statement of the Problem

Depending on the locality, the seasonal availability of pasture may make it profitable to provide some supplementary feed as a regular annual practice. In most of the more arid regions of Australia, however, drought is an irregularly occurring disaster for which separate and specific provision needs to be made. "Dry snaps" of one or two months without rain, when things get "pretty well eaten down" are not uncommon. It is only if the dry snap continues, and graziers have to start feeding their sheep, that a drought is considered to have begun. Whether sheep are collected into yards or left in three or four thousand acre paddocks, drought feeding is a dry lot operation since *no other feed is available.* For simplicity a hypothetical Merino wether property will be considered where two pounds of wheaten hay per day per animal has been found to maintain the flock in drought without serious death losses. In a normal season wheaten hay can be produced (or purchased) and stored for £8 per ton. Droughts, which occur at irregular intervals, are characterized by a rapid increase in the price of feed, and an even faster decline in the price of stock. Thus the alternative of selling stock and buying back in again after the drought may be assumed even less profitable

[1] For a fuller description of the inventory problem see John F. Magee, *Production Planning and Inventory Control,* New York: McGraw-Hill Book Co., 1958; and T. M. Whitin, *The Theory of Inventory Management,* 2nd Ed., Princeton: Princeton University Press, 1957.

[2] Another agricultural example, using a rather different model, has been presented by George Tolley, and Cleon Harrell. *See Management of Meat Inventories, Journal of Farm Economics,* Vol. 37, 1955, p. 252.

than feeding the stock on the farm. It is usual for the price of fodder to double during a drought so that we may expect the price of wheaten hay to increase to £16. 0. 0. a ton.

Now the farmer is faced with the alternatives of not storing any fodder, and hence having to pay £16 a ton when the drought finally arrives, or accumulating a reserve at £8 a ton in good seasons, and hence tying his capital up in "inventory." As in most risk problems, the farmer can make two "errors." He can accumulate a fodder reserve, and not need it, or he can fail to accumulate a reserve and need it. In the first case the cost will be the capital he has unnecessarily tied up, and in the latter case it will be the increased cost of feed during the drought. In an inventory problem *a priori* knowledge of the probabilities is used to balance the losses from these two types of "error."

In general the optimum fodder reserve will be larger as:

(1) the probability of a drought is increased,
(2) the cost of obtaining fodder in a normal season is decreased,
(3) the cost of obtaining fodder in a drought is increased, and
(4) the less urgently capital is needed for other forms of investment.

For simplicity it will be assumed that the fodder reserve decision is made once a year, and that the probability of encountering a drought next season is unaffected by the rainfall of the immediately preceding season. Thus the optimum inventory problem recurs each year, and if it is correctly solved for one year it is correctly solved for all years.[3]

Algebraic Statement of the Problem

Let the longest expected drought be n months, where the probability of having to drought feed sheep (from stored or purchased hay) in the ith month is P_i, $i = 1, 2, \ldots, n$, and

$$1 \geq P_1 \geq P_2 \geq \cdots \geq P_n \geq P_{n+1} = 0 \tag{1}$$

Then the expected number of months for which it will be necessary to feed is:

$$Q = \sum_{i=1}^{n} P_i \qquad (2)^4$$

If a ton of wheaten hay will provide 40 wethers with two pounds a

[3] My *Journal* referee, quite correctly, took exception to this last statement. In practice, until the meteorologists can tell us much more about climate than they can at present, the estimated probability of future droughts will depend upon historical experience. Hence, each new season will alter the expected frequency of drought, and this will alter the problem. However, if the probability distribution were known with certainty, then each time a drought broke, and wheaten hay was available at £8 a ton, exactly the same problem of how much to store, would recur.

[4] Note that if the probability of having to feed for i months is p_i, then the ex-

day for a month and the cost of buying a ton of wheaten hay in a normal season is c and the cost in a drought is d, then the expected annual cost of feeding 40 sheep with *fodder purchased during a drought is:*

$$C_0 = d \sum_{i=1}^{n} P_i \tag{3}$$

If one ton of fodder were stored, then the expected annual cost of feeding 40 sheep would become

$$C_1 = cP_1 + d \sum_{i=2}^{n} P_i + cr(1 - P_1) \tag{4}$$

Where r is the internal rate of interest, and

the first term is the cost of stored fodder multiplied by the probability it will be needed, and

the second term is the cost of purchasing succeeding months' feed if needed, and

the third term is the annual cost of storing one month's fodder supply if it is not needed, multiplied by the probability that it will not be needed.

Similarly if k months' feed is held in reserve, the expected cost will be:

$$C_k = c \sum_{j=1}^{k} P_j + d \sum_{i=k+1}^{n} P_i + cr \sum_{j=1}^{k} (1 - P_j) \tag{5}$$

The minimum expected cost of the farmer's fodder reserve, C min, is now given by:

$$C \min = \min_{k} C_k \qquad k = 0, 1, 2 \cdots n \tag{6}$$

Note that if the analyst knows the way in which prices rise in suc-

---

pected total number of months for which we will have to feed is:

$$Q = \sum_{i=1}^{n} ip_i \tag{2'}$$

and the probability of having to feed in the kth month is:

$$P_k = \sum_{i=k}^{n} p_i$$

Thus (2) can be written:

$$\begin{aligned}(2)\ Q = \sum_{i=1}^{n} P_i &= \sum_{i=1}^{n} p_i + \sum_{i=2}^{n} p_i + \cdots + \sum_{i=n-1}^{n} p_i + p_n \\ &= 1p_1 + 2p_2 + \cdots + (n-1)p_{n-1} + np_n \\ &= \sum_{i=1}^{n} ip_i = Q \qquad (2')\end{aligned}$$

ceeding months of drought, so that the cost of fodder in the ith months is d_i, then equation (5) can be replaced by (5′):

$$C_k = c\sum_{j=1}^{k} P_j + \sum_{i=k+1}^{n} d_i P_i + cr\sum_{j=1}^{k}(1 - P_j) \tag{5'}$$

Equations (5) and (5′) reveal that the apparently complex problem of deciding the annual cost of a given feed reserve, when the demand for it is unknown, can be broken down quite simply into the cost associated with the feed if it is needed, plus the cost of purchasing additional feed at inflated prices, plus the cost of storing the feed reserve if it is not needed.

A Numerical Example

As a numerical example, it will be convenient to consider a region of New South Wales where past experience suggests the probability P_i of having to feed for i months is:[5] $P_1 = .20$, $P_2 = .16$, $P_3 = .14$, $P_4 = .13$, $P_5 = .11$, $P_6 = .10$, $P_7 = 0$.

The normal cost c of wheaten hay is £8 a ton while the drought price d is £16 a ton. A ton of wheaten hay will feed 40 sheep for a month; hence for simplicity the expected cost of feeding 40 sheep will be considered. Considering the internal rate of interest to be 5 per cent, (3) says that the cost of having no fodder reserve would be:

$$C_0 = d\sum_{i=1}^{n} P_i \tag{3}$$

or

$$\begin{aligned} C_0 &= £16\sum_{i=1}^{6} P_i \\ &= £(16(.20 + .16 + .14 + .13 + .11 + .10)) \\ &= £(16 \times .84) \\ &= £13.44 \end{aligned}$$

Similarly, if one ton of fodder were stored, the appropriate figures inserted in (4) would give

$$\begin{aligned} C_1 &= £8 \times .20 + £16(.16 + .14 + .13 + .11 + .10) \\ &\quad + £(8 \times .05)(1 - .20) \\ &= £1.6 + £10.24 + £.32 \\ &= £12.16 \end{aligned}$$

[5] The estimates of the P_i can be based on the experience of graziers who have had up to 50 years in the district. It is probably better to base these probabilities on the

TABLE 1. EXPECTED COST IN POUNDS OF DROUGHT FEEDING 40 SHEEP AS THE FODDER RESERVE AND INTERNAL RATE OF INTEREST VARY

Fodder Reserve	Internal Rate of Interest			
	5 Per Cent	10 Per Cent	20 Per Cent	50 Per Cent
None	13.44	13.44	13.44	13.44
1 month	12.16	12.48	13.12	14.40
2 months	11.22	11.87	12.18	17.11
3 months	10.44	11.44	13.44	19.44
4 months	9.75	11.10	13.80	21.90
5 months	9.21	10.93	14.34	24.57
6 months	8.79	10.85	14.98	27.37

Appropriate substitution in (5) for the remaining months leads to the left hand column of Table 1. Substitution with r = .10, .20 and .50 leads to the remaining three columns of Table 1.

To obtain C min (which appears in (6)) for each interest rate it is only necessary to inspect each column of the table. This inspection shows that:

when r = .05, C min = 8.79, and
" r = .10, C min = 10.85, and
" r = .20, C min = 12.18, and
" r = .50, C min = 13.44

These minimum costs for fodder reserves mean, in turn, that with an internal rate of interest of 5 per cent or 10 per cent the grazier should hold six months' hay supply. At an interest rate of 20 per cent, the fodder reserve should be reduced to two months' supply, while at an interest rate of 50 per cent the cost of tying up capital is, understandably, too high to justify any reserve at all. Clearly, the higher the return which could be obtained on capital invested elsewhere, the smaller the reserve which will minimize the farmer's expected cost.

General Remarks

Depending on the level of sophistication that the data will stand, the above model can be refined to take account of considerably more complex problems. Thus deterioration of the fodder as a result of being stored, and the possibility of purchasing a "fodder reserve" early in a drought (i.e. before there had been a serious price rise) could also be taken into account. If the probability of drought could be expressed, or approximated by a smooth function, then (6) could be replaced by an equation setting the first derivative of the resulting cost function equal to zero.

well-defined quantities, "months for which it was necessary to feed" rather than to rely on rainfall records. The latter can be misleading since *when* rain falls, and how much falls at once are quite as important as the total fall.

Finally, it may be observed that this inventory problem could equally well be approached as a zero-sum two-person game (the farmer vs. Nature) in which Nature's mixed strategy is known. Thus the farmer has seven pure strategies (to carry zero, one, two, three, four, five or six months' fodder reserve) and Nature has corresponding pure strategies of from zero to six months' feeding required. To each pair of pure strategies there is a corresponding pay-off. If Nature plays two months' drought, when the farmer plays zero fodder reserve, the pay-off to the farmer is —£32 (two tons of wheaten hay purchased at £16 a ton). However, historical experience permits the farmer to estimate the frequency with which Nature will use each of her pure strategies. That is, the farmer can estimate Nature's mixed strategy, and this enables him to select the pure strategy for which his loss will be minimized. This minimum loss has been referred to above as C min.

ESTIMATING VARIATIONS IN PRODUCTION AND INCOME OVER TIME IN FARM PLANS FOR THE GREAT PLAINS

REX D. HELFINSTINE
Agricultural Research Service, USDA

THE relative variability in production and income arising from physical factors is a neglected criterion for evaluating farm plans for the Great Plains. This note describes a technique that was developed for evaluating variability in farm plans.[1]

The traditional criterion of average annual income (computed by budgeting or linear programming) is inadequate for Great Plains conditions. In the Plains, incomes vary widely from year to year because seasonal precipitation and such natural hazards as hail, hot winds, grasshoppers, and plant diseases vary greatly. A farm plan that offers the highest average income potentials is not attractive to a farmer if it will bankrupt him during a series of low-income years. Farm plans should be selected on the basis of both income-producing potential and low probable variation in annual income. The problem is to develop a technique to test plans for

[1] Rex D. Helfinstine and L. W. Schaffner, "Irrigation Farming and Dryland Farming Can Work Together on the Cannonball River," *North Dakota Agricultural Experiment Station Bulletin* 385, June, 1953;

Rex D. Helfinstine, "Economic Potentials of Irrigated and Dryland Farming in Central South Dakota," *South Dakota Agricultural Experiment Station Bulletin* 444, May, 1955; and

Rex D. Helfinstine, "An Economic Comparison of Dryland Farming and Potential Irrigation Farming in Central South Dakota," Ph.D. Thesis, University of California, Berkeley, 1958.

relative variability. A technique of this kind using coefficients of annual variations as criteria is described.[2]

This note lists the assumptions that were followed for a 480-acre cattle-hog farm in a South Dakota study, one phase of which compared the relative variability of dryland and partly irrigated farm plans. It discusses the assumptions, presents an example, and summarizes the procedure used.[3]

The need for the South Dakota study arose from the possibility of irrigating the dryland farming area of central South Dakota from Oahe reservoir.[4] The problem was to determine the relative profitability and variability of dryland and irrigated farming for the area.

The 480-acre farm discussed represented a modal size group of present dryland farms in the area. It had 330 acres of cropland, 145 acres of range pasture and hay, and 5 acres of farmstead. Comparisons were made of income and variability, assuming 0, 40, 60, and 80 per cent of the land irrigated.

The use of relative historical changes in production appeared to be the most realistic basis for evaluating the variability of production and income from alternative farm plans. In this instance, the historical base used was the period 1926-52. Average yields in Beadle county, as reported by the United States and South Dakota Departments of Agriculture Crop and Livestock Reporting Services, were used.[5]

The simplifying assumptions that were made to isolate the variability factor and to keep the computations manageable were as follows:

(1) A constant level of prices would prevail during the 27-year period;

(2) Crop yields on dry cropland would vary by the same relative amount that they did historically in Beadle county for the period 1926-52. The average level of these crop yields equaled the expected yields estimated by a committee of agronomists of the South Dakota agricultural

[2] The coefficient of variability is not a fully satisfactory measure of the type of income variability experienced by Great Plains farmers and ranchers. A series of low-income years that puts a farmer out of business is a critical aspect of variability, which is not measured by the coefficient of variability. Unfortunately, no simple statistical measure of this aspect has been worked out. Some work has been done along this line by cumulating net cash income above a living allowance over a series of years.

[3] Comparison was made also of the relative variability of dryland and partly irrigated farm plans for a 320-acre dairy-hog farm, and for an 800-acre cattle-hog farm.

[4] Oahe reservoir will be formed by a dam constructed by the U. S. Army Engineers across the Missouri River near Pierre, South Dakota. When completed, the reservoir will have a total storage capacity of 23.6 million acre-feet, of which 5.5 million will be for dead storage, 3.5 million for flood control, and 14.6 million for the multiple purposes of power, irrigation, and recreation. Storage for irrigation is expected to be sufficient for irrigating 1 million acres of land in central South Dakota.

[5] Beadle county, one of the counties in the study area, appeared to be representative of the area.

experiment station. Yields reported for the county for these years were converted into relatives and multiplied by the expected yields.

(3) Crop yields on irrigated cropland were assumed to vary by the same relative amount as those reported annually for the years 1926-52 for the Belle Fourche irrigation project.[6] The average level of these crop yields was also that estimated by the committee of agronomists. The Belle Fourche yields were converted to relatives and multiplied by these estimated yields.

(4) It was assumed that total cattle sales and costs varied directly with the amount of the previous year's pasture production: as indicated for dryland pasture by the pasture condition reported by the Crop Reporting Service for eastern South Dakota, and for irrigated pasture by the yield of alfalfa hay reported by the Bureau of Reclamation for the Belle Fourche irrigation project. Both these indications of pasture condition were converted to relatives and multiplied by the pasture yields estimated by the committee of agronomists.

(5) Hog sales and costs and poultry sales and costs were assumed to remain constant throughout the period at 30 litters of pigs and 100 hens each year.

(6) The costs of tractor and machinery operation, and of hired labor were assumed to remain constant throughout the period.

The implications and justification for these assumptions may be of interest. The first assumption of constant prices was adopted in order to isolate the problem of income variability arising from physical variation in production. It is granted that such an assumption is not realistic because widespread droughts, such as those that occurred during the 1930's will reduce supplies of livestock feed and livestock to an extent that will affect prices. This assumption of constant prices implies that any production changes occurring as a consequence of drought are so localized or so balanced by the release of government-owned feed stocks as not to affect prices. An assumption of constant prices should have little effect on a comparison of the relative variability of alternative plans, if both are dryland plans. However, a comparison of relative variability of dryland and irrigated farm plans, based on constant prices, may understate the variability of the dryland plan relative to the irrigated plan, if production from the study area represents a high proportion of total national production.

The assumptions that crop yields vary with a county or project average should not affect the relative variability of the different plans.[7] However,

[6] "Crop Summary and Related Data," Federal Reclamation Projects, U. S. Bureau of Reclamation, annual publications, 1926-52. The Belle Fourche project is located in northwestern South Dakota.

[7] The sizes of the project area and the county selected were comparable. Thus, variability should not have differed because of this factor.

the absolute variability will be understated for individual farm situations. This follows because of the localized effects of hailstorms, insect and disease infestations, and the variation in the management factor.

The assumption that beef cattle sales and costs vary directly with the previous year's pasture production comes reasonably close to the historical pattern. A comparison of the coefficient of variation for cattle production from 1926 to 1952 in Beadle county with the coefficient of variation of this model, in which cattle production varied directly with the previous year's pasture production (as shown by the 1926 to 1952 pasture production indices for the general area), indicates approximately an equal coefficient of variation.[8] This similarity does not signify that each varied in the same amount at the same time (a positive correlation of 1); it means that the same degree of variability is introduced into the problem by this assumption as occurred historically on a county basis. Moreover, a scatter diagram indicated a high degree of association between cattle on farms and pasture condition in the previous year. Historically, variations in livestock production have been influenced by both changes in relative prices and changes in feed production. It is unlikely, even under the assumption of constant prices, that all farmers could make as rapid an upward adjustment in livestock production as in feed production. The assumption implies that breeding stock is available for purchase at inventory prices, which would allow these upward adjustments.[9] This would be true in practice only in case of localized drought.

The assumption of constant hog and poultry sales and costs does not conform to actual farm conditions. Price expectations, disease and weather hazards, and available feed supplies all affect the numbers of hogs and poultry raised. The influence of price expectations has been removed by the constant price assumption, while the influence of disease and weather hazards is unpredictable (uncertain) and thus is not considered. Production of feed grains is generally in excess of requirements for hogs and poultry, so it is assumed that a storage program could take care of needs. The general effect of this assumption of constant hog and poultry sales and costs is to remove the influence of changes in hog and

---

[8] The coefficient of variation for the January 1 number of cattle on farms in Beadle county from 1926 to 1952 was 26.1 per cent; the coefficient of variation for cattle production that varied directly with 1926-52 pasture production indices for the general area was 26.8 per cent.

Furthermore, a scatter diagram of cattle on farms plotted against pasture condition the previous year indicated a higher degree of association than when plotted against pasture condition in the same year.

[9] The significance of this assumption is to show lower expenses in years following drought than is true in practice. For, in general, it could be expected that replacement breeding animals would cost more in years following drought than their inventory values. This leads to underestimation of the coefficient of variability of net incomes on dryland farms relative to irrigated farms, as net incomes would tend to be even lower at such times than estimated.

poultry production on income variability. Such an assumption is likely to understate the variability on the dryland farm relative to the irrigated farm.

The assumption of constant costs of tractor and machinery operation and of hired labor fails to reflect precisely the actual situation. In case of drought, it may be presumed that there would be a slight decline in total operating costs, which would come about because less hired labor would be needed for the smaller numbers of livestock and less tractor fuel and oil would be required to harvest the smaller production of crops. It seemed unlikely that this difference in operating costs was important. However, it would tend to overstate slightly the variability on the dryland farm relative to that on the irrigated farm.

A summary of the calculations for the 480-acre dryland farm, organized as a cattle-hog farm, may help to make this discussion concrete. (See Table 1). This table shows the contributions to gross income each year from wheat, barley, corn, and cattle. Negative contributions would represent purchases or withdrawals from inventory. Total sales include the varying contributions from the three crops and cattle plus a constant figure of $7,716 from hog and poultry sales. Total expenses include a varying charge for cattle expenses (averaging $235) plus $6,391 additional expenses for hog and poultry feed, equipment expense, building expense, taxes, insurance, depreciation, and interest on investment.

Some figures comparing the highest, lowest, and average labor income from 1926 to 1952, as well as the coefficient of variation, for the 480-acre farm on both a dryland and an irrigated basis will illustrate the magnitude of the coefficients that were computed.[10]

		40 Per Cent	60 Per Cent	80 Per Cent
	Dryland	Irrigated	Irrigated	Irrigated
Highest income	$11,764	$12,278	$13,524	$14,476
Lowest income	—2,281	1,639	3,001	3,566
Average income	4,539	7,173	9,313	10,162
Coefficient of variation (per cent)	88	40	30	28

As previously mentioned, this farm was organized as a beef-cattle-hog farm but with varying proportions of irrigated land.

It appeared to be meaningful to compare coefficients of variation of annual incomes for dryland and partly irrigated farms in central South Dakota, using certain simplifying assumptions. The simplifying assump-

[10] Rex D. Helfinstine, "An Economic Comparison of Dryland Farming and Potential Irrigation Farming in Central South Dakota," Ph.D. Thesis, University of California, Berkeley, 1958, Table 29, p. 189.

TABLE 1. SUMMARY OF COMPUTATIONS FOR ESTIMATING LABOR INCOME FROM 1926 THROUGH 1952, ON A 480-ACRE DRYLAND CATTLE-HOG FARM, CENTRAL SOUTH DAKOTA, ASSUMING CONSTANT PROJECTED PRICES

Year	Wheat Sales at $1.55 per bu.[a]	Barley Sales at $1.05 per bu.[b]	Corn Sales at $1.20 per bu.[c]	Cattle Sales[d]	Total Sales[e]	Total Expenses[f]	Labor Income
	Dollars	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*	*Dollars*
1926	542	−1,068	260	1,098	8,548	6,614	1,934
1927	3,408	2,560	2,122	867	16,673	6,567	10,106
1928	1,383	612	− 416	1,480	10,775	6,692	4,083
1929	2,339	323	746	1,168	12,292	6,628	5,664
1930	2,753	2,049	70	1,225	13,813	6,640	7,173
1931	642	−1,091	−1,836	1,191	6,622	6,633	− 11
1932	2,068	801	−1,136	751	10,200	6,544	3,656
1933	− 186	−2,192	−1,679	1,306	4,965	6,657	− 1,692
1934	− 214	−2,192	−1,818	775	4,267	6,548	− 2,281
1935	1,868	22	− 818	324	9,112	6,457	2,655
1936	− 186	−2,170	−1,782	1,156	4,734	6,626	− 1,892
1937	756	− 779	−1,484	578	6,787	6,509	278
1938	1,882	679	− 938	902	10,241	6,574	3,667
1939	1,083	− 656	−1,270	1,087	7,960	6,612	1,348
1940	1,640	− 534	−1,246	890	8,466	6,572	1,894
1941	2,224	713	−1,817	1,087	9,923	6,612	3,311
1942	2,824	2,248	1,648	1,237	15,673	6,642	9,031
1943	1,127	− 556	− 112	1,561	9,736	6,708	3,028
1944	2,296	− 334	2,396	1,306	13,380	6,657	6,723
1945	4,621	2,760	972	1,549	17,618	6,706	10,912
1946	2,781	1,125	1,462	1,468	14,552	6,689	7,863
1947	3,694	1,836	− 23	1,341	14,564	6,664	7,900
1948	3,280	2,438	3,616	1,387	18,437	6,673	11,764
1949	1,868	290	− 185	1,445	11,134	6,685	4,449
1950	2,468	757	1,301	1,191	13,433	6,633	6,800
1951	3,793	2,460	1,279	1,306	16,554	6,657	9,897
1952	1,226	− 189	688	1,549	10,990	6,706	4,284
Mean							4,539
Standard deviation							3,980
Coefficient of variation							88%

[a] Value of production from 92 acres, less 138 bushels for seed, assuming an average yield of 15 bushels per acre, but varying relatively with 1926–52 Beadle county yields.

[b] Value of production from 106 acres, less 2,088 bushels for seed and feed, assuming an average yield of 23 bushels per acre, but varying relatively with 1926–52 Beadle county yields.

[c] Value of production from 99 acres less varying quantity fed to cattle and less 1,404 bushels fed to hogs, assuming an average yield of 16 bushels per acre, but varying relatively with 1926–52 Beadle county yields.

[d] Computed from index of cattle sales (based on amount of previous year's pasture production) multiplied by average sales of $1,156.

[e] Total of grain and cattle sales plus $7,716 from hog and poultry sales.

[f] Computed from index of cattle sales multiplied by varying cattle expenses averaging $235 plus $6,391 other expenses.

tions used tended to understate the coefficient of variation for the dryland organization relative to the irrigated organization but would give relatively more accurate answers in comparing different organizations on a dryland farm or different organizations on an irrigated farm. In this particular example, labor income increased and variability decreased with increases in proportion of irrigated land. If the example showed one plan with highest labor income and highest variability, the value of the technique would be more apparent.

DIFFERENCES IN COSTS AND RETURNS OF STAMPED AND BUSINESS REPLY ENVELOPES IN A MAIL SURVEY

JAMES DUNCAN SHAFFER
Michigan State University

THIS report is the result of a test to determine the differences in costs and returns between the use of stamped return envelopes and business reply envelopes in a mail survey.

Random samples of 1000 were selected from the address section of the city directory of each of four Michigan cities. The return envelopes were stamped for half of the sample of each city and business reply envelopes were used for the other half. Two follow-up mailings were made, each with a questionnaire and return envelope. The first follow-up was mailed 10 days after the initial mailing and the second 12 days later. The questionnaires from each of these three mailings had number codes indicating with which group it was mailed. The number of returns from each mailing is based upon which of the three questionnaires was returned rather than the date when the return was received. Thus a number of the questionnaires from the initial mailing were received after the first follow-up was mailed. Some of these might have been returned as a result of being reminded by the receipt of the follow-up questionnaire. On the other hand, some respondents who answered on the second questionnaire would have undoubtedly gotten around to answer the first questionnaire sooner or later. We have assumed these two errors in estimated returns from each mailing would cancel out. If they did not, then there is some error in the estimated per cent returned and cost per questionnaire among the three mailings.

The questionnaire itself consisted of 41 opinion, attitude, or information questions dealing with food buying and six questions related to socio-economic characteristics. The questionnaire was four pages in length printed on pink paper.

Records were kept of each operation involved in the survey.[1] All of the cost of preparing the sample and mailing list was charged to the initial mailing. Costs of the two follow-up mailings were based upon the actual number of units mailed. The number mailed exceeded the difference between the total sample and the number received because a number of questionnaires from the previous mailing were received after the next mailing was made. The per cent returned for each mailing represents the actual number of questionnaires returned divided by the number in the initial mailing less number actually returned from previous

[1] I would like to acknowledge the assistance of Mary Strickland Holmes, graduate student in agricultural economics, in assembling the cost figures.

TABLE 1. COMPARISON OF COSTS BETWEEN STAMPED AND BUSINESS REPLY ENVELOPES IN A MAIL SURVEY

	Cost per unit	Initial mailing				First follow-up				Second follow-up			
		Stamped		Business reply		Stamped		Business reply		Stamped		Business reply	
		No. of units	Total cost	No. of units	Total cost	No. of units	Total cost	No. of units	Total cost	No. of units	Total cost	No. of units	Total cost
Materials & Handling—mailing out	$.067	2000	$134.00	2000	$134.00	1372	$ 91.92	1591	$106.60	1023	$ 68.54	1267	$ 84.89
Postage—out	.04	2000	80.00	2000	80.00	1372	54.88	1591	63.64	1023	40.92	1267	50.68
Postage—return[a]	.04 or .06	2000	80.00	499	29.94	1372	54.88	217	13.02	1023	40.92	122	7.32
Stamp "licking"	.0058	2000	11.60	—	—	1372	7.96	—	—	137	.79	—	—
Checking in	.048	637	30.58	499	23.95	272	13.06	217	10.41	137	6.58	122	5.86
Preparation of sample & mailing list[b]	(102.00)	—	102.00	—	102.00	—	—	—	—	—	—	—	—
Total cost			$438.18		$369.89		$222.70		$193.67		$157.75	122	$148.75
Average cost per unit returned	—	637	$ .69	499	$ .74	272	$ .82	217	$ .89	137	$ 1.15		$ 1.22

[a] The $.04 rate applies to the "stamped" envelopes and the $.06 rate to the business reply envelopes.
[b] Fixed cost applied to the first wave only.

mailing. Table 1 shows what went into the cost calculations for each of the three mailings assuming a 4 cent postage rate for regular mail.[2]

The per cent of questionnaires returned was higher and the cost per questionnaire returned was lower for each mailing when the stamped envelope was used as compared with the business reply envelope. This is shown in Table 2. For the total the stamped envelope resulted in 25 per cent higher returns than the business reply envelope. As a result of the higher returns, the unit cost of the questionnaire was lower using the stamped envelope than with the business reply envelope.

The effect of the postage rate increase on the cost of a mail survey is

TABLE 2. DIFFERENCES IN COSTS AND RETURNS FROM A MAIL SURVEY USING STAMPED AND BUSINESS REPLY ENVELOPES

	Returns				Cost per questionnaire returned			
	Business Reply		Stamped		Business Reply		Stamped	
	No.	%	No.	%	3¢ postage rate	4¢ postage rate	3¢ postage rate	4¢ postage rate
Initial mailing	499	26.2	637	33.4	$ .69	$ .74	$ .62	$ .69
First follow-up	217	15.4	272	21.4	.81	.89	.72	.82
Second follow-up	122	10.2	137	13.7	1.10	1.22	1.00	1.15
Total[a]	838	43.9	1046	54.8	.78	.85	.70	.78

[a] The per cent returned is based upon an initial sample of 3,814. The post office inidcated 186 of the original 4,000 addresses were vacant houses.

also shown in Table 2. The increases in postage rate increased the cost of each questionnaire returned by business reply envelope by 9 per cent and those returned in stamped envelopes by 11 per cent.

Table 2 also indicates the higher cost per questionnaire returned incurred in each mailing. The percentage returns from the follow-up mailings in this particular survey were substantially lower than from the initial mailing and the costs per questionnaire returned were higher as a result. This was true even though the entire cost of drawing the sample and preparing the mailing list was charged to the initial mailing.

A further question is whether or not the responses of persons answering a mail survey using a stamped envelope are significantly different from those answering one using a business reply envelope. To test this, the responses of those returning the questionnaire from the two samples

[2] At the time of the surveys the rate was still 3 cents. The data for the 4 cent rate assume the response rates would be the same as with the 3 cent stamp and simply adds the extra cost which would be involved.

were compared for nine questions. These questions dealt with size of family, family income, age of homemaker, education of homemaker, attitude toward trading stamps and knowledge of egg grades, apple grades, beef grades, and seasonal prices of meat. A chi square test was used to determine the level of significance in the differences between the distribution of the responses to these nine questions. In no case was a significant difference indicated using a 5 per cent critical level of significance.

Summary

The use of a stamped envelope in place of business-reply envelope resulted in a higher percentage of returns and lower cost per questionnaire for both the initial mailing and for each of two follow-up mailings in a mail survey of homemakers.

There was no significant difference in the distribution of responses between the two methods.

ECONOMETRIC MODELS IN AGRICULTURE

Chairman: Karl Fox, Iowa State College

LINEAR PROGRAMMING MODELS FOR THE DETERMINATION OF PALATABLE HUMAN DIETS*

VICTOR E. SMITH
Michigan State University

WHEN George Stigler showed us how to feed a grown man for one year at a cost of $39.93 (at August, 1939, prices),[1] he gave us a dramatic illustration of how little purely nutritional needs have to do with the level of actual food expenditures. It is not recorded that Stigler's diet—wheat flour, cabbage, spinach, evaporated milk, and dried navy beans—has been widely adopted.

If we want diets that someone might be willing to eat, we need models that take account of tastes and habits. The three models I am presenting illustrate the way in which "conventional" restraints can be used in programming models to raise the level of palatability of the diet, unquantifiable as palatability may be.

The problem is to select a set of quantities of foods that will meet nutritional and conventional specifications at the least cost. Let n be the number of foods, p_j the unit price of commodity j, λ_j the quantity of commodity j to be consumed, m the number of restraints, b_i the quantitative requirement or limit set by the ith restraint, and a_{ij} the contribution of one unit of commodity j toward meeting the ith quantitative requirement or limit.

We minimize

$$\sum p_j\lambda_j, \qquad (j=1, 2, \cdots, n)$$

subject to

(1) $$\lambda_j \geq 0$$

and

(2) $$\sum a_{ij}\lambda_j \lesseqgtr b_i \qquad (i=1, 2, \cdots, m).$$

* Journal Paper No. 2375 from the Michigan Agricultural Experiment Station. James D. Shaffer suggested the problem; Gerald G. Quackenbush and Shaffer contributed advice and assistance, plus data from the Michigan State University consumer panel; Louise Kelley advised on nutritional matters. This study was made partly under a fellowship granted by the Ford Foundation. However, the conclusions, opinions and statements set forth here are those of the author and not necessarily those of the Ford Foundation.

[1] George J. Stigler, "The Cost of Subsistence," *Journal of Farm Economics*, May, 1945, pp. 303-314.

The Midget Model

The simplest model has $m = 12$ and $n = 73$. The 12 restraints embody the first 12 of the nutritional requirements in Table 1.

For the most part these are the allowances recommended by the Food and Nutrition Board of the National Research Council,[2] assuming that we have a family of two 45-year-old adults and one 18-year-old daughter.[3] We added allowances for phosphorus, fat and carbohydrates.

The only concession to palatability which is made in the midget model is embodied in the selection of the list of eligible foods.[4] This list is based upon reports of actual food purchases by the 176 families in the Lansing,

TABLE 1. NUTRITIONAL REQUIREMENTS FOR A FAMILY OF THREE FOR FOUR WEEKS

Row Number	Nutritional Element	Type of Requirement	Amount	Unit
1	Calories	$\geq$	207.200	1000 calories
2	Protein	$\geq$	5.460	Kilogram
3	Fat	$\geq$	5.6532	Kilogram
4	Carbohydrates	$\geq$	20.720	Kilogram
5	Calcium	$\geq$	81.200	Gram
6	Phosphorus	$\geq$	103.600	Gram
7	Iron	$\geq$	1.092	Gram
8	Vitamin A	$\geq$	420.000	1000 Int'l Units
9	Thiamin	$\geq$	106.4	Milligram
10	Riboflavin	$\geq$	137.2	Milligram
11	Niacin	$\geq$	1,064.	Milligram
12	Ascorbic Acid	$\geq$	6.300	Gram
13	Calories	$\leq$	227.920	1000 calories

Michigan, area who participated in the Michigan State University consumer panel during each week of 1955.[5] Any item of food "consumed"[6] at some time during the course of the year by at least 90 per cent of the families is included in the list. Often no single item was so widely consumed, but a certain group of commodities, such as milk, soups, or biscuits and rolls, was represented in the consumption of at least 90 per cent of the families. In these cases the list includes all items in the group that were consumed by at least 50 per cent (88 families). In the cake group, where the classification was very detailed, no single item met the 50 per

[2] *Recommended Dietary Allowances,* National Research Council Publication 302, Washington, D.C., revised 1953, pp. 1-3, 22.

[3] The mean size of family in our sample of consumer purchasing habits was 3.086 persons.

[4] Only natural foods are included; they contain nutrients (some unknown) necessary to health but absent from synthetic vitamin preparations.

[5] See Gerald G. Quackenbush, "Demand Analysis from the MSU Consumer Panel," *Journal of Farm Economics,* August, 1954, pp. 415-427.

[6] Purchased, grown, received as a gift, or obtained by hunting or fishing—and not given away.

cent test, so I included the two most popular items, angel food cake (not iced) and jelly roll, bought by 84 and 83 families respectively.

The data giving the nutritional composition of each food were provided by Louise Kelley.[7] They allow for waste such as outside leaves, bone, etc., but they do not take account of loss of nutritive value during cooking or in the form of table scraps.

The prices used in the model are averages of the prices actually paid by the members of the consumer panel during May of 1955. In each week a weighted average price was computed for each commodity by dividing the total expenditure by the total quantity purchased.[8] The unweighted average of these weekly averages (their sum divided by their number) was taken as the average price for the four-week period.[9] A price of $10.000 indicates that the commodity was believed to be unavailable during the period involved.

The midget model provides a diet that will feed a family of three for four weeks at a cost of $28.33 (Table 2). With only six ingredients, it is a bit dull, and it runs rather heavily to potatoes and flour (over five pounds a day of the two together). The 139 pounds of milk correspond to 65 quarts, or 2.3 quarts per day. I suppose the menu will have to consist largely of potato soup, creamed potatoes, creamed carrots, and milk. Of course nothing can be salted. About twice a month there will be a great day when the picnic ham is bought, and for some time afterward our friends can have scalloped potatoes baked with bits of ham.

TABLE 2. MIDGET MODEL SOLUTION

Commodity		Quantity (Lbs. per 4-wk. period)	Price (Dollars per lb.)	Expenditure (Dollars per 4-wk. period)
Number	Name			
1120	Milk—Fresh, Homogenized, Plain	139.116	$.082	$11.41
2120	Oleomargarine	4.373	.240	1.05
4470-1	Carrots—Fresh	6.035	.160	.97
4841-1	Potatoes—Fresh	83.415	.060	5.00
5346	Pork—Picnic Ham, Cured Butts	10.473	.341	3.57
6692	Flour—White, Enriched	65.906	.096	6.33
	Total Expenditure			28.33

The most difficult problem is disposing of those 66 pounds of flour.

[7] Margaret A. Ohlson, Louise Kelley, and Gerald G. Quackenbush, "The Nutritional Value of Food Purchased in 1953 by 146 Urban Families," Michigan State University Consumer Panel Bulletin No. 4, Michigan State University Agricultural Experiment Station, Technical Bulletin No. 258, 1956, p. 10.

[8] Less than the quantity consumed by the amount of gifts, etc.

[9] In a few cases an average of three or more periods was used.

There is neither yeast nor baking powder in the diet, so we may have to eat flour paste. However, despite the starchy character of the diet, it is not fattening: calories are at the minimum level permitted. Since we are inclined to think that protein requirements are expensive to meet, it is interesting to note that this diet furnishes about 20 per cent more than the minimum requirement.

Unenthusiastic as we might be about this diet, I am told that diets of this basic structure were common three decades ago in southern Sweden and in parts of east-central Europe. For myself, I rate its palatability a little above either of the Stigler diets.[10] Wheat flour and cabbage were the only two of the seven commodities in his diets that were sufficiently popular to be included in the commodity list for this model. Moreover, our fat requirement, which he did not have, was effective, and increased the number of commodities in the diet by one.

The present diet is also considerably more expensive than Stigler's. His diet for August, 1939, prices would feed three men for four weeks at a cost of $25.44, if bought at the prices paid in our sample in May, 1955. His diet for August, 1944, prices is still cheaper: $21.61 at May, 1955, prices.

The Small Model

The small model, like the midget model, follows the principle of restricting choice to popular foods, but adds some explicit conventional restrictions. There are 39 restraints, in all, and 83 commodities. One nutritional restriction is new, No. 13 in Table 1. This sets a maximum limit upon the number of calories.

The explicit conventional restraints begin in Table 3. With this model it will be unnecessary to advise anyone to eat dry wheat flour or flour paste, as Stigler's diets and my midget model might require. The complementarity restrictions provide yeast, baking powder and other cooking accessories to go with any flour that may be in the solution, plus a spread for our bread and dressings for our leafy salad vegetables if these also appear

[10] Stigler's Least-Cost Annual Diets for a Moderately Active Man*

Commodity	At August, 1939, Prices	At August, 1944, Prices
Wheat Flour	370 lbs.	535 lbs.
Evaporated Milk	57 cans	—
Cabbage	111 lbs.	107 lbs.
Spinach	23 lbs.	13 lbs.
Dried Navy Beans	285 lbs.	—
Pancake Flour	—	134 lbs.
Pork Liver	—	25 lbs.

* *Op. cit.*

TABLE 3. COMPLEMENTARITY RESTRICTIONS[a]

Row Number	Description of Complementarity	Restriction
14	Butter and Oleo to Bread and Rolls	$-(\lambda_{2110}+\lambda_{2120})+.1344\,(\Sigma\lambda_j)\leq 0 (j=6101,\cdots,6260)$
15	Salad Oils and Dressings to Green Leafy Vegetables	$-(\lambda_{2210}+\lambda_{2220}+\lambda_{2221}+\lambda_{2230}+\lambda_{2231})+.1359(\Sigma\lambda_j)\leq 0$ (j runs over all fresh green leafy vegetables except fresh sauerkraut)
16	Cooking Fats and Oils to Flour	$-(\Sigma\lambda_k)+.2347(\Sigma\lambda_j)\leq 0 \quad (k=2110,\cdots,2210) \quad (j=6690,\cdots,6694)$
17	White or Powdered Sugar to Cake and White Flours	$-\lambda_{7100}+1.0466(\lambda_{6690}+\lambda_{6692}+\lambda_{6693})\leq 0$
18	Baking Chocolate to Cake and White Flours	$-\lambda_{9321}+.01580(\lambda_{6690}+\lambda_{6692}+\lambda_{6693})\leq 0$
19	Yeast to Bread Flours	$-\lambda_{9372}+.001719(\lambda_{6691}+\lambda_{6692}+\lambda_{6693})\leq 0$
20	Meat Sauces to Meats	$-\lambda_{9340}+.001102(\Sigma\lambda_j)=0 \quad (j=5110,\cdots,5598)$
21	Baking Powder to Flour	$-\lambda_{9311}+.01135(\Sigma\lambda_j)=0 \quad (j=6690,\cdots,6694)$
22	Baking Soda to Flour	$-\lambda_{9312}+.02572(\Sigma\lambda_j)=0 \quad (j=6690,\cdots,6694)$
23	Extracts to Cake and White Flours	$-\lambda_{9330}+.007609(\lambda_{6690}+\lambda_{6692}+\lambda_{6693})=0$

[a] The subscripts are the commodity numbers. These equations apply to the large model as well. In the small model those commodities not included in the small model commodity list simply disappear from the restraint equations.

in the solution. Consider the first restriction (No. 14), which can be written

$$.1344\ \Sigma\lambda_j \leq \lambda_{2110} + \lambda_{2120},$$

where $\Sigma\lambda_j$ represents the pounds of bread and rolls in the solution and λ_{2110} and λ_{2120} are the pounds of butter and of oleo, respectively. This restraint requires that the weight of butter and margine shall be at least 13.44 per cent of the weight of the bread and rolls—half of the average ratio for all the 176 families in our sample, nonconsumers and consumers alike. (The model does not require any butter or oleo for home-baked bread.)

There is no maximum ratio, because butter and oleo have many other uses. The requirement is set well below the average level because (1) part of butter and oleo consumption is used in other ways than as a spread, and (2) this leaves room for the programming technique to force some economy in the use of these spreads. For the same reasons each of the next five complementary restrictions (Nos. 15 through 19) is set at 50 per cent of the average consumption ratios for these categories.

Restraints 20 through 23 require exact fulfillment of the observed average consumption ratios between the commodities involved. Baking

powder and soda, extracts, and meat sauces have few uses other than those included in these complementarity restrictions. (These models do not allow for the small boy who fuels rockets with your baking soda and vinegar.)

Most of the complementarities concern raw materials which are not palatable in themselves and only become acceptable as foods when combined with their fellows. Whether these restrictions still leave an insuperable task for the cook who would prepare her menus from the ingredients of our diet remains to be seen.

There are other materials needed by the cook (salt, pepper, spices, vinegar, and prepared mustard) which cannot conveniently be tied to the

TABLE 4. MAXIMUM CONSUMPTION LIMITS: SMALL MODEL

Row Num-	Commodity Number	Commodity or Group	Type of Require-ment	Quantity Limit (Lbs. per 4-wk. period)
30	1610	Cheese, Natural American	≤	1.962
31	1820	Cheese, Cottage	≤	4.154
32	2120	Oleomargarine	≤	6.538
33	4120-1	Cabbage, Fresh	≤	5.009*
34	4841-1	Potatoes, Fresh	≤	49.087*
35	5130	Ground Beef or Hamburger	≤	9.692
36	5380, 5381	Sausage	≤	1.962*
37	5510	Wieners and Franks, etc.	≤	2.769
38	6101	Bread, Enriched White	≤	17.154
39	6711, 6714, 6715, 6716, 6722, 6723, 6724, 6725, 6726, 6731	Spaghetti and Macarion	≤	2.527*

* 2.5 times the mean consumption per consuming family.

consumption of any of the foods. In this model these five, plus coffee, are required in amounts equal to the average consumption per capita, with no adjustment for the fact that some persons may not use some items.

The last of the conventional restraints in the small model are a set of 10 which set maximum limits on the quantities of certain foods which might turn out to be so economical that they would appear in excessive quantity (See Table 4). These restraints protect against monotony. I relied upon general information in selecting the list of foods to be restricted: American cheese, cottage cheese, oleo, cabbage, potatoes, ground beef, sausage, wieners, white bread, and spaghetti and macaroni. With experience a better list could be chosen.

Where it was convenient to make an array of families by their consumption of a particular commodity, I set the maximum equal to the consumption of the lowest family in the top decile. In other cases I set the annual maximum at 2.5 times the mean annual consumption per consuming family. (Maxima based on the array ranged in the neighborhood of two to three times the mean consumption per consuming family.)

The list of commodities is the same as for the midget model, except for the addition of 10 cooking aids: baking powder, baking soda, baking chocolate, extracts, meat sauces, spices, pepper, vinegar, yeast, and mustard. All of these except yeast, meat sauces, and baking powder were purchased during the year by at least 50 per cent of the families in the sample. Prices and nutrient values are the same as for the midget model.

As might be expected, the increased complexity of the small model leads to a solution which is more palatable, but more expensive (See Table 5.). All the commodities of the midget solution are present, but in changed quantities: for one thing, potatoes and flour have been reduced by some 30 and 40 pounds, respectively. Adding about $6 to the outlay enables one to add sugar, oranges, eggs and Wheaties (about 24 boxes of these), plus coffee and the 11 cooking aids. The six items starred in Table 5, which the model required in predetermined quantities, account for $2.58 of the extra outlay. Coffee alone accounts for $2.34 of this.

TABLE 5. SMALL MODEL SOLUTION

Commodity		Quantity (Lbs. per 4-wk. period)	Price (Dollars per lb.)	Expenditure (Dollars per 4-wk. period)
Number	Name			
1120	Milk—Fresh, Homogenized, Plain	128.707	$ .082	$10.55
2120	Fats—Oleomargarine	5.799	.240	1.39
3240-1	Citrus—Oranges, Fresh	14.243	.108	1.54
4470-1	Green and Yellow Vegetables—Carrots, Fresh	3.754	.160	.60
4841-1	All Other Vegetables—Potatoes, Fresh	49.087	.060	2.95
5346	Pork—Picnic Ham, Cured Butts	2.354	.341	.80
5700-2	Eggs—Extra Large	9.469	.294	2.78
6001	Cereal—Wheaties	17.649	.319	5.63
6692	Flour—White, Enriched	24.710	.096	2.37
7100	Sugar—White or Powdered	25.861	.100	2.59
*8420	Beverages—Coffee, Regular	2.592	.901	2.34
9311	Cooking Aids—Baking Powder	.280	.276	.08
9312	Cooking Aids—Baking Soda	.636	.114	.07
9321	Cooking Aids—Chocolate, Baking	.390	.851	.33
9330	Cooking Aids—Extracts	.188	2.134	.40
9340	Cooking Aids—Meat Sauces	.003	.644	.00
*9350	Cooking Aids—Salt	.684	.069	.05
*9360	Cooking Aids—Spices	.0295	1.841	.05
*9361	Cooking Aids—Pepper	.0195	1.697	.03
*9371	Cooking Aids—Vinegar	.471	.141	.07
9372	Cooking Aids—Yeast	.042	1.226	.05
*9436	Cooking Aids—Mustard, Prepared	.168	.235	.04
	Total Expenditure			34.71

* These commodities were required to be present in predetermined amounts.

The maximum limit on potatoes has cut down their quantity. The complementarity restraints based on flour have brought in 26 pounds of sugar and a variety of cooking aids along with the flour. Fortunately, the solution contains eggs, so the housewife can bake cakes.

These complementarity restraints have also raised the effective cost of including flour in the diet and thus have cut down its quantity. Probably this is why Wheaties, not so encumbered, have popped into the solution in such quantity. Restraint 15, by requiring salad oils with green leafy vegetables, has actually kept fresh cabbage out of the diet, though it would have appeared had no salad dressings been required with it.

The Large Model

The large model has $m = 98$ and $n = 572$. The increase to 98 restraints will provide greater variety in the diet; one large set of restraints forces part of the diet into a conventional pattern by setting minimum quantities for many commodities that are widely consumed. The list of eligible foods in this model includes each item "consumed" at some time during the course of the year by as many as nine different families (5 per cent of the 176 families reporting), with a few exceptions. A complete list of the 572 commodities and their prices may be had upon request. This extended list opens new possibilities for economizing, but it still excludes many items, for instance, 100 per cent whole wheat flour, lima beans in the pod, yogurt, and coffee substitute. It also includes many items that would not be generally palatable; if only 5 per cent of the sample buy the commodity, 95 per cent have rejected it.

Table 6 lists the new maximum consumption limits obtained by apply-

TABLE 6. ADDITIONAL MAXIMUM CONSUMPTION LIMITS: LARGE MODEL

Row Number	Commodity Number	Commodity or Group	Type of Requirement	Quantity Limit (Lbs. per 4-wk. period)
40	1310	Milk, Powdered Skim	≤	1.296
41	2130	Lard	≤	1.385
42	3219-3	Grapefruit Juice (Single Strength), Canned	≤	2.428
43	3248-3	Orange Juice (Concentrated), Canned	≤	.577
44	3249-3	Orange Juice (Single Strength), Canned	≤	4.385
45	4121-3	Sauerkraut, Canned	≤	1.169
46	4701-4	Beans, Navy, Baked, White, Dried	≤	1.308
47	4703-4	Beans, Kidney, Dried	≤	.538
48	4871-3	Tomatoes, Canned	≤	2.288
49	4873-3	Tomato Juice, Canned	≤	3.335
50	5141	Beef and Baby Beef Liver	≤	.799
51	5181	Stewing Beef (Boneless)	≤	1.154
52	5183	Boiling Beef	≤	1.302
53	5351	Pork Liver	≤	.692
54	5391	Side or Salt Pork	≤	1.015
55	6011, 6014, 6016, 6022, 6028, 6029	Cereals, Cooked	≤	2.433*
56	6104	Bread, Whole or Cracked Wheat	≤	7.308
57	6691	Flour, Graham	≤	1.923

* 2.5 times the mean consumption per consuming family.

TABLE 7. MINIMUM CONVENTIONAL REQUIREMENTS

Row Number	Commodity Number	Commodity or Group	Type of Requirement	Quantity Required (Lbs. per 4-wk. period)
58	1110, . . . , 1140	Milk, Fresh	≥	75.828
59	1610, 1620	Cheese, American	≥	1.244
60	2110, 2120	Butter and Oleomargarine	≥	4.379
61	2130, . . . , 2210	Cooking Fats and Oils	≥	1.712
62	4130–5, 4420–5, 4530–5, 4701–5, 4780–5, 4811–5, 4846–5, 4871–5, 4901–5, 4991–5, 4992–5, 5580, 5693	Soups	≥	2.739
63	5160, . . . , 5173	Beef, Steaks and Roasts	≥	6.534
64	5340, . . . , 5346	Pork, Ham	≥	3.012
65	5380, 5381	Pork, Sausage	≥	.685
66	5611–31, 5611–32	Chicken, Broilers or Fryers	≥	2.012
67	5700–2, 5700–3, 5700–4, 5700–5	Eggs	≥	8.179
68	All numbers on list from 5811–03 through 5894	Fish and Sea Food	≥	1.909
69	6001, 6002, . . . , 6010, 6012, 6013, 6015, 6017, 6018, 6019, 6020, 6023, 6024, 6025, 6030, 6031, 6042, 6043	Cereals, Ready-to-Serve	≥	1.787
70	6301, . . . , 6378	Cake	≥	.733
71	6711, . . . , 6731	Spaghetti or Macaroni	≥	.888
72	7511, . . . , 7573	Nuts and Nut Products	≥	1.201

ing the small model rules to the larger commodity list. This model also introduces a new principles, that a palatable diet should provide some of the pleasures common to our meals. Therefore the model requires minimum amounts of those 41 foods or groups of foods that were consumed by at least 90 per cent of the sample.[11] Table 7 lists the minima applied to groups of items; the minima applied to specific items are indicated by the commodity levels marked with double asterisks in Table 8. Where the requirement applies to a group, the programming procedure finds the least costly way of fulfilling it. In all cases the procedure determines whether the least-cost diet will contain more than the minimum requirement.

The level of these minima is set equal to three times the per capita consumption, including those persons who consume none of the commodity or group. The specific level chosen is essentially arbitrary, but dropping too far below the average consumption figure risks a solution in which some commodities will be present in such small quantities that they cannot be used in ordinary ways. Our minima are already somewhat below the average for only those members of the panel who consume a particular commodity.

[11] Fresh cantaloupe and fresh peaches were excluded because they are not always available.

TABLE 8. LARGE MODEL SOLUTION

Commodity		Quantity (Lbs. per 4-wk. period)	Price (Dollars per lb.)	Expenditure (Dollars per 4-wk. period)
Number	Name			
1120	Milk—Fresh, Homogenized, Plain	75.828	$.082	$6.22
1520	Ice Cream—Pre-packaged	3.903**	.267	1.04
1620	Cheese—Processed American (Velveeta, etc.)	1.244	.518	.64
1820	Cheese—Cottage Cheese	2.003**	.279	.56
2120	Fats—Oleomargarine	4.379	.240	1.05
2130	Fats—Lard	1.385	.188	.26
2131	Fats—Swiftning	.327	.256	.08
2221	Oils—Salad Dressing	.773**	.284	.22
3240-1	Citrus—Oranges, Fresh	5.808**	.108	.63
3245-3	Citrus—Orangeade and Orange Base, Canned	2.201	.104	.23
3310-1	Other Fruits—Apples, Fresh	6.956**	.132	.92
3340-1	Other Fruits—Bananas, Fresh	4.255**	.162	.69
4120-1	Green Leafy Vegetables—Cabbage, Fresh	1.770**	.102	.18
4130-1	Green Leafy Vegetables—Celery, Fresh	1.055**	.229	.24
4210-1	Green Leafy Vegetables—Lettuce, Head, Fresh	1.746**	.269	.47
4470-1	Green and Yellow Vegetables—Carrots, Fresh	1.192**	.160	.19
4530-5	Green and Yellow Vegetables—Peas, Soup	2.739	.180	.49
4811-4	All Other Vegetables—Onions, Mature, Dried	5.955**	.102	.61
4841-1	All Other Vegetables—Potatoes, Fresh	18.544**	.060	1.11
4871-1	All Other Vegetables—Tomatoes, Fresh	5.430**	.347	1.88
5130	Beef—Ground Beef, Hamburger	4.666**	.420	1.96
5141	Beef—Beef Liver and Baby Beef Liver	.190	.345	.07
5164	Beef—Chuck Roast (Pot Roast)	6.534	.481	3.14
5311	Pork—Bacon	1.757**	.518	.91
5330	Pork—Chops	1.196**	.729	.87
5346	Pork—Picnic Ham, Cured Butts	3.012	.341	1.03
5351	Pork—Pork Liver	.692	.236	.16
5381	Pork—Sausage	.685	.434	.30
5510	Other Meat and Meat Mixtures—Wieners and Franks, etc.	1.273**	.530	.67
5511	Other Meat and Meat Mixtures—Bologna, Salami, etc.	1.021**	.547	.56
5611-31	Poultry—Chicken, Broilers or Fryers, Ready to Cook, Fresh	2.012	.516	1.04
5700-2	Eggs—Extra Large	8.179	.294	2.40
5893	Fish and Sea Food—Sardines in Sauce, Canned	1.999	.340	.68
6016	Cereal—Oatmeal	1.135	.142	.16
6017	Cereal—All Bran, 40% Bran, Krumbles	.554	.289	.16
6018	Cereal—Shredded Wheat, Wheat Chex	.601	.265	.16
6030	Cereal—Wheat Germ Flakes	.631	.395	.25
6101	Bread—White, Enriched	8.972**	.184	1.65
6280	Crackers—Soda, Others Similar	.810**	.283	.23
6351	Cake—Loaf, No Frosting	.733	.377	.28
6410	Cookies—Plain or Sugared	.722**	.439	.32
6671	Mixes—Pancake or Waffle Mix, Buckwheat	7.610	.158	1.20
6692	Flour—White, Enriched	3.304**	.096	.32
6731	Spaghetti and Macaroni—Bag or Sack, Plain	.888	.205	.18
6958	Hominy	28.533	.102	2.91
7100	Sugar—White or Powdered	7.278**	.100	.73
7120	Sugar—Brown	.714**	.138	.10
7360	Candy and Sweets—Other Candy and Sweets	.687**	.450	.31
7415	Prepared Dessert Mixes—Gelatin, Flavored (Jello, Royal, etc.)	.302**	.414	.13
7511	Nuts and Nut Products—Coconuts, in Shell	1.201	.338	.41
8420	Coffee, Regular	2.592[b]	.901	2.34
9340	Cooking Aids—Meat Sauces	.012	.644	.01
9350	Cooking Aids—Salt	.684[b]	.069	.05
9360	Cooking Aids—Spices	.0295[b]	1.841	.05
9361	Cooking Aids—Pepper	.0195[b]	1.697	.03
9371	Cooking Aids—Vinegar	.471[b]	.141	.07
9436	Cooking Aids—Mustard, Prepared	.168[b]	.235	.04
	Total Expenditure			43.58[c]

** This is the minimum quantity of this item permitted by the model.
[b] This quantity specifically required in the model.
[c] Differs from the sum of the parts because of rounding error.

In addition to the new restraints discussed above, this model contains all the restrictions used in the small model. However, the complementarity restrictions (Table 3) in this model are not applied to any of the 26 minimum quantities identified by double asterisks in Table 8. Since these quantities represent the average consumption levels of those commodities consumed by at least 90 per cent of the families, a great many complementarities are already built into them.

To summarize, the large model provides average quantities of coffee, condiments, and those foods that are consumed by 90 per cent of the families in the sample. It takes account of some complementarities among foods, and it limits the consumption of certain foods to quantities known to be within the capacity of a family of three persons. It requires that the whole set of commodities meet specified nutritional requirements, and that the set chosen shall be the least costly set which can be chosen from these 572 commodities in such a way as to satisfy all of these conditions. The diet is intended to be nutritious, reasonably palatable and inexpensive. It need not be exciting, though it might be unconventional. It is a diet for a worldly ascetic.[12]

Table 8 contains the solution of the large model. For a total outlay of $43.58 the diet can include 57 commodities. Six of these, costing $2.58, are coffee and the five condiments. Twenty-six more, costing $17.49, are foods required in specified minimum quantities (marked with double asterisks in Table 8). The diet provides meats, eggs, fish, orangeade and fresh fruits and vegetables, not to mention ice cream, cake, candy and nuts. Potatoes, flour and sugar appear only at their minimum levels.

In meeting the minimum conventional requirements for groups of items (Table 7), the computations select the most economical sources of the combinations of nutrients that are needed to supplement those provided by foods selected to meet other conventional restrictions in the model. For this model and these prices, canned sardines in sauce are the most economical fish; plain spaghetti and macaroni in a bag or sack is the best buy in its group; extra large eggs are most economical in the egg group; and coconuts in the shell are the best buy in the nut group. The requirement for ready-to-serve cereals is met best by dividing one's purchases almost equally among (1) Shredded Wheat or Wheat Chex, (2) Wheat Germ Flakes, and (3) All Bran, 40% Bran, or Krumbles.

None of the items appear in unusual quantities except buckwheat pancake mix (7.6 pounds) and hominy (29 pounds—about one pound per day). Obviously the model needs maximum limits on hominy and on the pancake mixes.[13] The existing maximum restraints have kept lard and pork liver within bounds.

Like the others, this diet provides the minimum quantity of calories.

Evaluation

These models are based upon the assumption that conformity to conventional patterns of food purchase is one way to control the level of

[12] I owe the phrase to my colleague, Daniel Fusfeld.

[13] Any part of the hominy can be replaced by corn meal (and the associated amounts of cooking fats, baking powder and baking soda) for an additional cost of $.0017 per pound, or less than $.05 if all the hominy is replaced. The diet will still meet nutritional requirements.

palatability of a diet. The more conformity built into the model, the less economy we can expect from the solution. However, even our large model solution represents a respectable degree of economy in comparison with actual food expenditures. The cost of this diet per meal per person amounts to only $.17. No family in the Michigan State University consumer panel in 1953 obtained 100 per cent or more of each of the nutrients recommended by the Food and Nutrition Board if it spent as little as $.20 per meal per person, and only 15 per cent of the families that spent between $.21 and $.25 per meal per person achieved this standard. Even expenditures above $.40 provided only 69 per cent of the families with 100 per cent of each of the allowances.[14] From the nutritional point of view there appears some room for improvement in the use of food expenditures.

As nutritionists know, the allowances themselves represent an oversimplified statement of nutritional requirements. Dieticians rely heavily on variety as a means of providing nutients that are essential but unspecified; programming models that provide plenty of variety may accomplish the same objective.

---

[14] Louise Kelley, Margaret A. Ohlson, and Gerald G. Quackenbush, "Nutritional Evaluation of Food Purchased by 146 Urban Families During 1953," *Journal of Home Economics*, Volume 48, 1956, p. 356

AN ECONOMETRIC MODEL OF THE EGG INDUSTRY

MARTIN J. GERRA*
Agricultural Marketing Service, USDA

THE use of the word "model" in the title of this paper points up, at least for me, the concept of what a model is and why economists construct models. In much of the recent discussion on the appropriate method of statistical estimation to be used in fitting economic models, I cannot help but feel that we have somewhat lost sight of the "what" and "why" of economic models while concentrating on the "how." In this report I shall concentrate on the "what" and "why," and only briefly touch on the "how."

I like to think of an economic model as something that relates to a coherent set of quantities and properties abstracted from the immense complexity of the real world around us. If we limit the area of our real world to the egg industry in the United States, for example, the quantities in the model become variables such as dozens of eggs, numbers of layers, dollars of income. The properties of the model become the assumptions made about demand, supply, and other behavior relations and identities that make up the egg industry.

The "why" of an economic model is useful knowledge. In discussing economic measurements Marschak points out that "knowledge is useful if it helps to make the best decisions."[1] Therefore, what we attempt to do in constructing an economic model is to provide a framework within which a decision-making process can take place. The need for such a decision-making framework for the egg industry can be portrayed by considering an individual farmer faced with the choice of resource allocation. To intelligently decide whether he should build a new laying house and double the size of his laying flock, our illustrative farmer should have an expectation of the level of egg prices for some future time periods. If, at the expected level of prices, the capital invested in the new laying house will yield a return commensurate with alternative uses for his capital, he will decide to build.

The "how" of economic models involves us in the difficult task of locating and developing the necessary data and of deciding upon the exact nature of the variables and relations to be used in statistically estimating relationships. The statistical model should be as consistent as possible with the economic model, although modification is often neces-

* The author gratefully acknowledges helpful suggestions from Anthony S. Rojko.

[1] Jacob Marschak, "Economic Measurement for Policy and Prediction," *Studies in Econometric Method*, William C. Hood, and Tjalling C. Koopmans, ed., Cowles Commission for Research in Economics Monograph 14, p. 1.

sary because of lack of data for some of the variables in the model or because of statistical considerations.

Formulating the Economic Model

The basic economic system for the egg industry consists of a complex set of behavior relations and identities. At the head of the system let us put a behavior relation to represent the households and firms of the United States. Each household reacts to a set of economic stimuli in a way that will be consistent with its institutional environment. If the household is making a decision as a consumer of eggs, it will act so as to attain the highest level on a preference scale for a given cash outlay. If the firm is making a decision as a marketer of eggs, it will act to attain an output that will increase or maximize its revenue.

If we are content to develop a model for the egg industry that practices abstraction to the highest degree, we could formulate a simple system consisting of two behavior relations and an identity:

$$Q_E,\ P_R;\ \text{Some } Z\text{'s (price-consumption relation)} \tag{1}$$

$$Q_F,\ P_R;\ P_G,\ \text{some } Z\text{'s (price-production relations)} \tag{2}$$

$$Q_E = Q_F + A\ \text{(consumption-production identity)} \tag{3}$$

The endogenous variables involved are: Q_E, the consumption of eggs; Q_F, the production of eggs; and P_R, the retail price of eggs. The predetermined variables needed to indicate the nature of the economic model are: P_G, the price of poultry ration; and A, miscellaneous uses for eggs other than as food by civilians, including net changes in stocks as of January 1 and net exports. In addition, in relation (1), we could specify disposable income (I); population (H); and the general price level (P_0), as some of the Z's. In relation (2), we could specify the number of layers and pullets not yet of laying age on farms on January 1, (L_J); the rate of lay per hen in each year, (Q_A); and a variable representing the marketing system (W), as some of the Z's.

Such a brief model, however, fails in answering the "why" of economic model building. After statistically estimating the relationships entailed in the model, it would provide only the minimum of knowledge for intelligent decision making, neglecting a great deal of information that we know about the behavior of consumers and marketers of eggs.

If we examine how the supply of eggs in a calendar year can be adjusted by producers, we notice two ways—by varying the number of replacement pullets started in the spring and by varying the number of layers removed from laying flocks. If the egg-feed ratio in the first half of the year, when producers are starting chicks for future flock replacement, is lower than the ratio for the corresponding period in the previous year, producers generally start fewer replacements. If the egg-feed

ratio is higher than a year earlier, they tend to increase the number of chicks started for flock replacement. The number of layers sold and consumed on farms where produced throughout the year is related to the egg-feed ratio prevailing in that year. When the egg-feed ratio is above the previous year, the number of layers sold and consumed on farms where produced is less than when the egg-feed ratio in the current year is below the ratio in the previous year. This indicates an interaction between demand and supply within the 12-month span of January through December.

When one utilizes this additional information about the behavior of producers, a much broader, and I feel more useful, series of relations opens up and allows for supply to be partially determined with price. These relations are:

Q_E, P_R; some Z's (price-consumption relation)	(1)
$Q_F = Q_A \cdot L_F$ (production identity)	(2.1)
$Q_E = Q_F + A$ (consumption identity)	(3)
$L_F = L_J + C_F - M - L_C$ (average number of layers identity)	(4)
C_F, P_F'; P_G' (replacement relation)	(5)
L_C, P_F; P_G (layers sold relation)	(6)
P_F, P_R, Q_E; some Z's (price level relation)	(7)
P_F', P_R', Q_E'; some Z's (price level relation)	(8)
P_R', Q_E', S'; some Z's (price-consumption relation)	(9)
S', Q_F; Q_F', F (storage relation)	(10)
$Q_E' = Q_F' - S'$ (consumption identity)	(11)

The additional endogenous variables brought into the relations and identities are: Q_E', the consumption of eggs; P_R', the retail price of eggs; P_F and P_F', the local market price of eggs; L_F, the average number of layers on farms during the year; C_F, the number of replacement pullets raised; L_C, the number of layers sold and consumed on farms where produced; and S', net into storage movement of shell, frozen and dried eggs. The additional predetermined variables are: M, number of layers dying during the year; P_G', the price of poultry ration; Q_F', production of eggs; P_O', the general price level; and F, profits made in the preceding year by speculators who held long positions on the September, October, and November shell egg futures contracts. For both the endogenous and predetermined variables, a symbol with a prime (′) indicates that the variable relates to the period January-June; lack of a prime indicates that the variable relates to the calendar year.

By considering Q_F', January-June farm egg production, to be predetermined although Q_F, annual farm egg production, is treated as an endogenous variable, we have assumed no supply response to price in the first

six months of the calendar year. This appears reasonable as few chicks are started for flock replacement in July-December, although there has been an increasing tendency on the part of some producers to start chicks in this period. In addition, producers generally cull in summer and fall. Classifying Q_F' as a predetermined variable, one therefore assumes that culling activity in response to changes in the egg-feed ratio in January-June is negligible, although culling activity over the entire calendar year is treated as responsive to the egg-feed ratio.

The economic reasons behind most of these relations should be clear from examining Figure 1. The factors illustrated there—physical and economic—largely determine the basic economic relationships that exist in the egg industry. Items that represent physical quantities are shown in boxes; factors representing price and value are shown in circles. The solid lines connecting the various items indicate the more important factors; the broken lines indicate factors that are relatively minor or operate only occasionally. Arrows indicate the principal direction of each factor. Double-pointed arrows indicate factors that are believed to be simultaneously related. The symbols in some of the boxes and circles refer to the variables used in the relations formulated above.

At this point, perhaps some comment is appropriate on the price-consumption relation (9) and the storage relation (10). The variable S', the net January-June into storage movement of shell, frozen, and dried eggs (on an equivalent shell basis), is introduced into the January-June price-consumption relation (9) for several reasons. The absolute level of January 1 stocks of eggs and changes in the level of stocks normally are of minor importance as a price making factor in the annual supply and distribution of eggs. However, because of the seasonal nature of egg production, the supply of fresh eggs available in the spring months of March through May is greater, and the supply in the fall months of August through October is less, than the average monthly supply over the entire year. This seasonal variation in supply gives rise to the role of storage. If it were not for storage, which serves to level the peaks and troughs in egg supplies, shell egg prices would tend to decline in the spring and rise in the fall to an extent greater than usually prevails. Because of this simultaneous relationship between the price of shell eggs in the January-June period and the quantity of eggs stored, the variable S' is treated as an endogenous variable, necessitating the addition of the storage relation (10).

Relation (10) brings together with the storage variable S', the variables Q_F and Q_F', representing trend in the seasonality of egg production, and the variable F, representing the role of speculators in the egg futures market. As the production of eggs has become less seasonal, the price incentive for storing eggs has diminished. By combining the variable Q_F' and Q_F in a ratio, we attempt to allow for this effect. The inclusion of

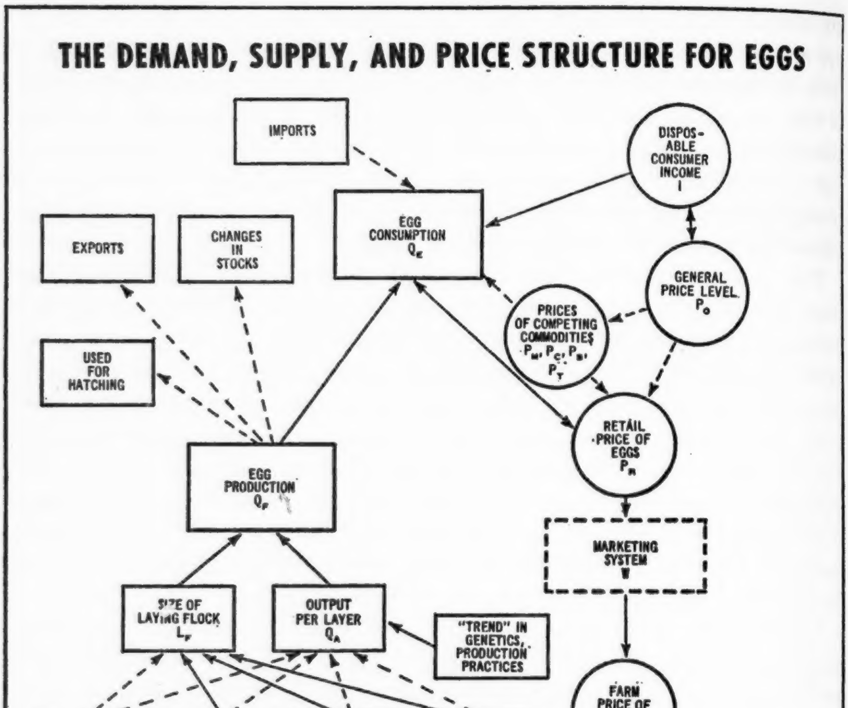
THE DEMAND, SUPPLY, AND PRICE STRUCTURE FOR EGGS
IMPORTS
DISPOS-ABLE CONSUMER INCOME I
EXPORTS
CHANGES IN STOCKS
EGG CONSUMPTION Q_E
GENERAL PRICE LEVEL P_G
PRICES OF COMPETING COMMODITIES P_M, P_C, P_B, P_T
USED FOR HATCHING
RETAIL PRICE OF EGGS P_R
EGG PRODUCTION Q_P
MARKETING SYSTEM W
SIZE OF LAYING FLOCK L_F
OUTPUT PER LAYER Q_A
"TREND" IN GENETICS, PRODUCTION PRACTICES
FARM PRICE OF EGGS P_F
MORTALITY RATE M
HENS AND PULLETS ON FARMS, JAN. 1 L_J
PULLETS STARTED JAN.-JUN. C_H
LAYERS SOLD* L_C
FARM PRICE OF EGGS JAN.-JUN. P_F'
NUMBER OF GRAIN CONSUMING ANIMAL UNITS ON FEED
PRICES OF LIVESTOCK AND LIVESTOCK PRODUCTS
PRICES OF COMPETING COMMODITIES JAN.-JUN. P_M', P_C', P_B', P_T'
SUPPLIES OF FEED CONCENTRATES
POULTRY FEED PRICES P_O
POULTRY FEED PRICES, JAN.-JUN. P_O'
MARKETING SYSTEM W
GENERAL PRICE LEVEL JAN.-JUN. P_G'
WEATHER
FUTURES PRICES F
NET STORAGE JAN.-JUN. S'
RETAIL PRICE OF EGGS, JAN.-JUN. P_R'
SEASONALITY IN PRODUCTION Q_P'/Q_P
EGG CONSUMPTION JAN.-JUN. Q_E'
DISPOSABLE CONSUMER INCOME JAN.-JUN. I
ARROWS SHOW DIRECTION OF INFLUENCE. SOLID LINES INDICATE MAJOR PATHS OF INFLUENCE.
SYMBOLS REFER TO NOTATION IN THE TEXT.
* AND CONSUMED ON FARMS WHERE PRODUCED
U.S. DEPARTMENT OF AGRICULTURE
NEG. 6095-58(4) AGRICULTURAL MARKETING SERVICE

FIG. 1

the variable F in relation (10) is an attempt to represent movements in the futures market by a partially reduced form procedure.

In studying the futures market for eggs, one notes that year-to-year changes in the net into-storage movement, after adjusting for the negative trend in storage, appear to be related to changes in the "basis" (the difference between the current spot price and the price of the nearest futures contract). By definition, changes in the basis reflect the interaction of movement in the spot and futures market. However, explanation of movements in the futures market entails the construction of an expectation model. Because such a model is difficult to construct with available data, an alternative approach is used.

This approach assumes that in order for springtime storers of eggs to protect their holdings by a hedging transaction, a sufficiently large group of speculators must exist in order to provide a liquid market on which eggs can be hedged. As the "basis" changes, affording storers the incentive to put more or less eggs into storage than normal, the amount of hedges to be placed to cover the cash market transactions changes concurrently. Consequently, the number of speculative long commitments needed to support the hedges also changes. We hypothesize that if the speculative operation in a particular year is profitable, speculators will show a greater willingness to enter the market the following spring, while unfavorable experiences lead to a lesser willingness. Assuming this premise, we can, by substitution, form a relation between the net into storage movement and the previous year's profit or loss on a speculative long contract.[2]

Fitting the Economic Model

As already mentioned, the "how" of economic models chiefly concerns the appropriate method of statistical estimation to be used in the fitting process. If simultaneous relationships are known to hold, a large, but not altogether unanimous, body would argue for the use of the method of limited information so as to obtain statistically consistent estimates of the parameters in the model. Opposed to this group are the advocates of the method of least squares who argue that their method, although it may

---

[2] We have assumed:

$$X = f(Y, u) \tag{a}$$
$$Y = f(Z, v) \tag{b}$$

where:

X = net into storage movement, January-June
Y = number of speculative long commitments, January-June
Z = profit on speculative long position, previous year
u, v = random error terms.

Then, a linear form of the model is

$$X = a_1 + b_{11}Y + u_1 \tag{c}$$
$$Y = a_2 + b_{22}Z + v_1 \tag{d}$$

and, by substitution:

$$X = a_1 + b_{11}(a_2 + b_{22}Z + v_1) + u_1. \tag{e}$$

not give consistent measures of the parameters in the model, will do the best job of predicting a variable as long as the structure of the model remains unchanged. In addition, we have other computationally feasible methods of fit, such as the method of instrumental variables and the Theil-Basmann method.

In fitting a model of the egg industry, we have used both the least squares method and the limited information method. This was not done with any intent to beg the question of fitting procedure, but in an attempt to reach some conclusion as to the relative merits of each method, insofar as they applied to statistically fitting the relations formulated in this paper. The final section of this paper will, to some extent, bring out these conclusions.

From the behavior relations and identities discussed above, two models were statistically fitted. Model I differed from model II to the extent that the price-consumption relations (1) and (9) in model I contained variables representing prices of items thought to be substitute or complementary goods with eggs (meats, poultry, and fish; cheese; ready-to-eat cereals; and bacon). In addition, relations (7) and (8) in model I contained a variable representing the quantity of eggs moving through marketing channels; relations (7) and (8) in model II did not.

The model was fitted to first difference values for the period 1931-54, with the years 1942-45 excluded. First differences were used because of the several trend factors that have affected the relationships.

Some Empirical Results

The "why" of model building centers interest on two aspects of a statistically fitted model, its coefficients and estimated values. As this model was fitted to first difference values of the data, it is more convenient to refer to elasticity measurements than to the actual coefficients. In a forthcoming bulletin, I shall present coefficients obtained by fitting several models by limited information and least squares methods. For the present purpose, however, I believe the measures of the more important elasticities presented in Table 1 should be satisfactory for appraising the merits of the models formulated and the methods of fit. Table 2 and Table 3 present for comparison elasticities of demand and supply obtained by other researchers.

Measures of the elasticity of demand with respect to the price of eggs during the period studied ranged from -0.09 to -1.96. Larger demand elasticities were obtained from the equations fitted by the limited information method than by the least squares method. Based on the statistically most significant coefficient, we would expect on the average that a 1 per cent change in the retail price of eggs would be associated inversely with about a -0.4 per cent change in the per capita consumption of eggs,

TABLE 1. EGGS: ESTIMATES OF PRICE, INCOME, AND OTHER ELASTICITIES BY TYPE OF ANALYSIS, BASED ON DATA FOR 1931–41 PLUS 1946–54[1]

Analysis and elasticity	Value	Standard error
	Per cent	*Per cent*
Demand elasticity with respect to—		
Own price:		
Simultaneous approach:		
Model I	−1.96[2]	6.01
Model II	− .40	.18
Least squares method:		
Model I	− .11[2]	.06
Model II	− .10[2]	.06
Equation (1)[3]	− .09[2]	.07
Equation (2)[4]	− .11[2]	.08
Income:		
Simultaneous approach:		
Model I	−1.33[2]	4.20
Model II	.04[2]	.20
Least squares method:		
Model I	− .08[2]	.12
Model II	.09[2]	.12
Equation (1)[3]	.11[2]	.11
Equation (2)[4]	.14[2]	.10
General price level:		
Simultaneous approach:		
Model I	2.10[2]	4.94
Model II	.89	.41
Least squares method:		
Model I	1.20	.39
Model II	.33[2]	.19
Supply elasticity with respect to—		
Price of poultry ration:		
Simultaneous approach:		
Model I	—[5]	—[6]
Model II	− .3	—[6]
Supply elasticity of pullets raised with respect to—		
Egg-feed ratio, January–June:		
Simultaneous approach:		
Model I	.40	.08
Model II	.44	.10
Least squares method:		
Model I, Model II	.43	.07
Supply elasticity of layers sold with respect to—		
Egg-feed ratio, annual average:		
Simultaneous approach:		
Model I	− .67	.19
Model II	− .60	.16
Least squares method:		
Model I, Model II	− .40	.09

[1] Elasticities computed at the mean value for the years 1931–41 plus 1946–54.
[2] Coefficient does not differ significantly from zero when tested at the 10 per cent level.
[3] Derived from least squares fit of year-to-year differences for the relation: $Q_E/H = f(P_R/P_0, I/HP_0)$.
[4] Derived from least squares fit of year-to-year differences of logarithmic values for the relation in footnote 3, above.
[5] Less than .05 per cent.
[6] Not computed.

TABLE 2. EGGS: ELASTICITIES OF DEMAND WITH RESPECT TO PRICE AND INCOME, BY TYPE OF ANALYSIS, FOR SPECIFIED PERIODS[1]

Study*	Period included in analysis	Method of analysis	Demand elasticity with respect to			
			Own price		Income	
			Value	Standard error	Value	Standard error
			Per cent	*Per cent*	*Per cent*	*Per cent*
Fisher (*1*):						
Model I[2]	1915–40	Simultaneous approach	−0.98[3]	0.52	1.33	0.52
Model II[4]	do.	do.	− .44	.13	.80	.19
Model III[5]	do.	do.	−.62 to −.78	—[6]	.56 to .89	—[6]
Model I[2]	do.	Least squares	− .22	.10	.52	.16
Model II[4]	do.	do.	− .20	.05	.54	.09
Model III[5]	do.	do.	− .24	.08	.37	.17
Fox (*2*)	1922–41	do.	− .43	.08	.57	.07
	do.	do.	− .34	.06	.49	.08
Judge (*3*)	1921–41	do.	− .53	.09	.31	.08
	do.	Simultaneous approach	− .58	—[6]	.44	—[6]
	1921–50	Least squares	− .32	.13	.43	.12
	do.	Simultaneous approach	− .60	—[6]	.27	—[6]
Nordin, Judge, and Wahby (*4*)	1921–41	Least squares	− .55	—[7]	.41	—[7]

[1] Elasticities from the study by Fisher were computed at the mean value. The remaining studies used logarithmic values and, therefore, elasticities were equal to the regression coefficients reported in each study.
[2] Uses values deflated by a measure of the general price level.
[3] Coefficient differs significantly from zero at the 10 per cent probability level but not at the 5 per cent level.
[4] Uses actual values rather than deflated values.
[5] Uses first differences of deflated values. Estimates of elasticities vary depending on the way author handled income and supply in the simultaneous model.
[6] Could not be computed as standard errors of regression coefficients not given in original study.
[7] Stated as statistically significant at the 5 per cent level.
* Italicized figures in parentheses refer to Literature Cited.

TABLE 3. EGGS: ESTIMATES OF SHORT-RUN AND LONG-RUN SUPPLY ELASTICITIES, BY TYPE OF ANALYSIS, FOR SPECIFIED PERIODS[1]

Short-run Elasticities

Study*	Period included in analysis	Method of analysis	Elasticity of supply with respect to: Own price — Value	Own price — Standard error	Feed price — Value	Feed price — Standard error
			Per cent	*Per cent*	*Per cent*	*Per cent*
Fisher (*1*):						
Model I[2]	1915–40	Simultaneous approach	0.20[3]	0.53	−0.16[3]	0.18
Model II[4]	do.	do.	− .11	—[5]	− .03	—[5]
Model III[6]	1925–40	Least squares	.22[3]	.13	− .11	—[5]
Judge (*3*)	1921–50	do.	.19[3]	.17	.01[3]	.15
	do.	Simultaneous approach	1.17	—[5]	− .97	—[5]
Long-run elasticities[7]						
Fisher (*1*) Model III[6]	1925–40	Least squares	2.2	—[5]	−1.1	—[5]

[1] Elasticities from the study by Fisher were computed at the mean value. The remaining studies used logarithmic values and, therefore, elasticities were equal to the regression coefficients reported in each study.
[2] Uses values deflated by a measure of the general price level.
[3] Coefficient does not differ significantly from zero when tested at the 10 per cent level.
[4] Uses actual values rather than deflated values.
[5] Could not be computed as standard errors of regression coefficients not given in original study.
[6] Uses first differences of actual values.
[7] Derived algebraically from a lagged equation given in (*1*, p. 58)
* Italicized figures in parentheses refer to Literature Cited.

after allowing for the effect of other economic factors. To increase per capita consumption by 1 per cent requires a price concession at the retail level of about 2.5 per cent, with an accompanying decline in consumers' expenditures for eggs. An elasticity of demand with respect to the price of eggs of -0.4 compares closely with the average of estimates derived in time series studies by other researchers. Estimates of demand elasticity in those studies ranged from -0.2 to -1.0, with an average for all the studies being about -0.4 to -0.5.

In the study on which this paper is based, a measure of the elasticity of demand with respect to the price of eggs also was obtained from household expenditure data. Using pooled 1955 and 1942 survey data for urban households, we obtained a demand elasticity with respect to price of -1.5.[2a] This measure is a great deal higher than the results obtained from time series data. We would expect a higher elasticity, however, because the variation in the price of eggs among income classes, especially for urban households, is due mainly to variations in the grade and size of eggs used. The price effect on consumption in a pooled cross section study mainly reflects this influence.

None of the demand equations fitted to time series data gave an elasticity of demand with respect to income that differed significantly from zero when tested at the 10 per cent level of statistical probability. Difficulty in obtaining a statistically significant income response from time series analysis appears to be due to the high degree of interrelationship among income, the price of eggs at retail, and the general price level. In addition, the per capita consumption of eggs has declined yearly from 1951 while income per capita has risen.

Based on the income elasticities that were larger than their standard errors but did not differ significantly from zero at the 10 per cent probability level, the elasticity of demand with respect to income derived from time series analysis probably falls within a range of zero to 0.2, after allowing for the effect of other economic factors. This range compares with an income elasticity obtained from cross-section data for all urbanizations in the spring of 1955 of 0.02, which differed significantly from zero at the 5 per cent probability level. In addition, an elasticity of demand with respect to income of 0.18, statistically significant at the 5 per cent level of probability, was obtained from pooled cross-section data for urban households in 1955 and 1942. Although measures of income elasticities obtained from cross-section data tend to be smaller than measures

[2a] Data from a 1948 survey of consumers' expenditures were not added to this analysis because the level of the 1948 consumption-income relationship, after adjusting for price level, differed significantly from the level of the 1955 and 1942 relationships.

from time series data, it appears reasonable to assume from the analyses presented in the bulletin referred to above that the elasticity of demand with respect to income for eggs for the period 1931-41 plus 1946-54 is very low, perhaps in the neighborhood of 0.1.

Other researchers have estimated elasticities of demand with respect to income ranging from 0.3 to 1.3, values substantially larger than those obtained in the analyses presented in this study. Part of the differences in income elasticities obtained in other analyses and the income elasticities obtained in this study arises from the different time periods used. Only two of the 13 analyses by other researchers included observations more recent than 1941; those two covered the period 1921-50. Intuitively, we expect that income elasticity would be greater in the pre-World War II period when income levels were much lower than in the post-World War II period. As the analyses in the bulletin referred to above included both pre- and post-World War II periods, we would expect a lower income elasticity than those obtained for pre-World War II analyses.

Measures of the elasticity of supply with respect to the price of eggs were not derived in this analysis because production responses were formulated with respect to the ratio of the farm price of eggs to the price of poultry ration. It was possible, however, from the reduced form equations based on the limited information fit of the model, to derive estimates of the elasticity of supply with respect to the price of poultry ration. These estimates indicate for the period 1931-41 plus 1946-54 a relationship between changes in the price of poultry ration and the quantity of eggs produced of zero to -0.3.

Elasticities of supply of pullets raised with respect to the January-June average egg-feed ratio and of layers sold with respect to the annual average egg-feed ratio were obtained for the years 1931-54 (excluding 1942-1945). On the average, a 1 per cent increase in the January-June average egg-feed ratio is associated with about a 0.4 per cent increase in the number of pullets raised. A 1 per cent increase in the annual average egg-feed ratio is associated, on the average with a -0.4 to a -0.7 per cent decrease in the number of layers sold and consumed on farms where produced.

In the studies of supply response by other researchers that are presented in Table 3, no supply elasticities were obtained that differed significantly from zero at the 10 per cent level of probability. However, based on elasticities whose values were larger than their respective standard errors, it appears that in about two-thirds of the time we could expect between a zero to 0.4 per cent increase in production following a 1 per cent increase in the average price received by farmers for eggs. No conclusions from those studies can be made about the magnitude of the elasticity of supply with respect to the price of feed because either error ranges were

not available or else the standard errors were larger than their regression coefficients.

Measures of long-run supply elasticities that are 10 times greater than the comparable short-run elasticities are reported in the study by Fisher. Some caution is warranted, however, in considering short-run versus long-run relationships in the egg industry. Because producers can adjust so rapidly in the egg industry, it seems unlikely that the long-run elasticity would be so different from the adjustment producers can make in one year to a price change, except in response to a price increase that might encourage expansion beyond the existing capacity of the industry.

Table 4 compares the actual values of the endogenous variables for the years 1948-57 with values estimated from the simultaneous approach and least squares fit of model I and model II of the egg industry. The values for the simultaneous approach were derived from a set of reduced form equations using coefficients from the limited information fit of the models. As the estimating equations were based on data for the period 1931-41 plus 1946-54, estimated values for the years 1955-57 represent extrapolations of relationships beyond the range of observations used.

As an aid in assessing the relative merits of the alternative models and methods used in estimating values in the egg economy, Table 5 shows the ratio of unexplained variation to total variation in the relevant economic variables within the egg industry for the years 1948-54, as well as for the years 1955-57. As the years 1948-54 include only part of the period for which the statistical coefficients of the models were fitted, and as the years 1955-57 were not included in the statistical fitting of the models, the ratio of the variation in a variable not explained by the model to the total variation in a variable can exceed 1.0.[3] For the period 1948-54, as well as for the years 1955-57, better estimates of the quantity variables appear to be obtained from the simultaneous fit of model I, while better estimates of the price variables appear to be obtained from the least squares fit of model I.

Based on percentage differences between actual and estimated values for the years beyond the period for which the models were fitted (Table 6), it appears that model I, fitted by the simultaneous approach, gives the best estimates of the endogenous variables in the egg economy among the models and methods of fit that were used. The reason for the better estimates appears to stem from the number of predetermined variables used in model I. By using the reduced form forecasting equations, each esti-

[3] Unexplained variation computed as the sum of the squared differences in each year between the year-to-year changes for a variable and its value estimated by specified model and method of fit. Total variation computed as the sum of the squared differences in each year of the year-to-year changes for a variable.

TABLE 4. ECONOMIC FACTORS IN THE EGG ECONOMY: ACTUAL AND ESTIMATED VALUES OF ENDOGENOUS VARIABLES, 1948–57

Year	Domestic egg consumption, Q_E					Farm egg production, Q_F					Layers on farms, L_F					Pullets raised, January–June, C_F				
	Actual	Estimated				Actual	Estimated				Actual	Estimated				Actual	Estimated			
		Simultaneous approach		Least squares			Simultaneous approach		Least squares			Simultaneous approach		Least squares			Simultaneous approach		Least squares	
		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II
	Bil.	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Mil.*
1948	56.5	57.2	60.9	56.4	57.5	54.9	55.9	59.6	54.9	56.0	331.6	332.6	332.6	—[a]	—[a]	386.0	385.7	415.3	410.9	410.9
1949	56.6	56.0	59.6	57.7	57.4	56.2	55.6	59.1	57.3	57.1	330.7	323.2	339.0	—[a]	—[a]	447.7	448.7	452.3	427.5	427.5
1950	58.5	56.3	65.6	59.2	59.3	59.0	56.9	66.2	59.8	59.9	339.5	322.4	347.8	—[a]	—[a]	393.6	362.4	430.2	394.0	394.0
1951	59.3	60.8	57.5	61.0	59.8	58.1	59.4	56.1	59.7	58.5	327.8	333.2	334.1	—[a]	—[a]	398.7	410.4	394.4	418.2	418.2
1952	59.8	60.3	61.2	61.9	61.7	58.1	58.6	59.5	60.1	59.9	320.5	319.4	328.8	—[a]	—[a]	370.2	379.3	385.2	358.8	358.8
1953	59.1	59.6	65.0	59.1	61.1	57.9	58.6	64.0	58.0	60.0	312.1	310.1	322.5	—[a]	—[a]	375.1	344.6	397.3	410.2	410.2
1954	59.8	59.4	61.1	60.6	61.7	58.9	58.6	60.3	59.9	61.0	314.2	307.9	318.4	—[a]	—[a]	369.8	375.0	373.8	359.8	359.8
1955	60.2	60.6	67.2	62.5	61.2	59.5	59.5	66.1	61.6	60.3	309.1	305.8	317.4	—[a]	—[a]	330.2	308.4	371.2	357.5	357.5
1956	60.8	59.7	62.2	63.6	62.3	60.8	59.6	62.1	63.5	62.2	309.9	300.8	329.1	—[a]	—[a]	349.4	338.2	346.0	356.3	356.3
1957	60.3	61.5	68.8	61.6	63.7	60.4	61.5	68.8	61.7	63.8	304.8	305.7	305.8	—[a]	—[a]	305.6	291.7	338.9	301.8	301.8

Year	Layers sold, L_C					Domestic egg consumption, January–June, Q_E'					Net into-storage movement, January–June, S'					Retail price, per dozen, P_R				
	Actual	Estimated				Actual	Estimated				Actual	Estimated				Actual	Estimated			
		Simultaneous approach		Least squares			Simultaneous approach		Least squares			Simultaneous approach		Least squares			Simultaneous approach		Least squares	
		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II
	Mil.	*Mil.*	*Mil.*	*Mil.*	*Mil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Bil.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*
1948	274.8	283.5	303.1	269.6	269.6	28.5	28.6	30.2	28.4	29.9	3.5	3.4	1.8	2.9	2.9	68.4	67.4	60.3	66.5	71.3
1949	244.7	253.1	256.7	249.3	249.3	30.4	27.9	30.7	29.3	30.0	1.6	4.1	1.3	2.5	2.5	65.9	59.3	59.2	60.8	66.6
1950	275.2	261.1	328.8	262.5	262.5	31.0	27.2	34.9	31.5	31.4	2.7	6.4	−1.2	2.2	2.2	57.1	61.8	45.9	60.0	64.0
1951	249.8	256.0	240.1	250.6	250.6	30.5	34.6	29.3	31.0	30.3	2.2	−1.9	3.4	2.2	2.2	69.7	65.6	69.0	68.4	64.3
1952	243.0	253.2	249.0	259.3	259.3	30.5	30.5	30.6	31.2	31.2	2.2	2.2	2.0	2.4	2.4	63.6	69.9	68.2	70.8	71.2
1953	237.8	209.3	262.0	212.9	212.9	30.3	33.4	31.9	30.5	31.0	1.4	−1.7	−.2	1.3	1.3	66.8	63.6	52.5	63.2	65.3
1954	235.6	247.1	245.9	255.6	255.6	29.8	27.0	31.4	29.9	30.2	2.0	4.8	.4	.8	.8	56.2	62.6	62.7	59.3	66.0
1955	227.0	224.9	287.4	239.6	239.6	30.0	35.4	34.5	31.8	30.8	2.0	−3.4	−2.5	−.6	−.6	58.1	53.2	38.7	56.4	55.2
1956	219.1	215.9	223.8	219.0	219.0	30.7	35.0	30.0	31.6	30.6	1.5	−2.8	2.2	3.0	3.0	57.7	57.2	55.9	59.8	58.8
1957	223.0	208.2	264.8	202.7	202.7	31.0	27.3	34.2	30.8	31.6	1.4	5.1	−1.8	.9	.9	54.9	57.0	43.91	58.2	62.8

(Continued on the next page)

TABLE 4 (*Continued*)

Year	Farm price, per dozen, P_F					Retail price, per dozen, January–June, P_R'					Farm price, per dozen, January–June, P_F'				
	Actual	Estimated				Actual	Estimated				Actual	Estimated			
		Simultaneous approach		Least squares			Simultaneous approach		Least squares			Simultaneous approach		Least squares	
		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II
	Ct.	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*	*Ct.*
1948	47.2	46.4	40.7	45.6	49.5	63.9	59.4	68.0	61.9	67.3	44.0	41.4	47.2	42.2	46.6
1949	45.2	40.0	39.6	40.0	45.3	63.2	61.1	62.3	59.9	63.2	43.3	43.8	43.2	39.6	43.2
1950	36.3	42.1	28.7	39.2	43.4	49.2	54.4	58.4	59.0	59.9	30.5	27.6	40.5	39.2	40.2
1951	47.8	42.8	46.1	46.6	42.6	64.6	71.4	57.4	60.6	57.3	43.4	39.2	36.2	40.2	37.1
1952	41.6	47.9	46.5	48.8	49.2	56.4	64.9	66.0	64.7	65.0	35.7	43.1	44.4	43.4	44.4
1953	47.7	42.0	32.4	41.6	43.2	63.6	73.9	59.5	61.4	59.7	44.9	28.4	37.7	40.4	38.7
1954	36.6	44.4	44.3	43.7	46.9	57.2	46.3	63.0	62.5	62.7	38.6	44.9	44.6	44.1	44.1
1955	38.9	34.0	22.2	37.0	35.8	53.9	86.0	56.1	60.7	57.4	35.8	26.2	37.7	42.3	39.2
1956	38.7	38.5	37.1	40.6	39.6	58.0	76.4	54.7	57.9	54.7	39.8	35.2	36.3	39.5	36.4
1957	35.2	38.1	27.3	39.7	43.8	49.3	43.6	59.3	56.7	59.7	30.7	30.0	40.4	38.7	41.7

[a] No least squares estimates made for this variable as they were included in an identity equation in both model I and model II.

TABLE 5. ANALYSIS OF VARIATION BETWEEN ACTUAL AND ESTIMATED VALUES IN THE EGG ECONOMY OBTAINED FROM ALTERNATIVE MODELS AND METHODS OF FIT, FOR SPECIFIED PERIODS[a]

Variable	1948–1954					1955–1957				
	Total variation in variable	Ratio of unexplained variation to total variation[b]				Total variation in variable	Ratio of unexplained variation to total variation[b]			
		Simultaneous approach		Least squares			Simultaneous approach		Least squares	
		Model I	Model II	Model I	Model II		Model I	Model II	Model I	Model II
Domestic egg consumption, Q_E (billions)	5.24	1.64[d]	22.99	1.84	2.62	0.69	4.07[d]	178.57	21.48	21.46
Farm egg production, Q_F (billions)	9.88	.84[d]	12.90	.95	1.52	1.82	1.46[d]	63.63	7.36	7.78
Layers on farms, L_F (millions)	389.25	1.09	.96[d]	—[c]	—[c]	23.21	4.07[d]	18.89	—[c]	—[c]
Pullets raised, January–June, C_F (millions)	9,579.94	.22[d]	.31	.29	.29	2,481.36	.32[d]	1.13	.33	.33
Layers sold, L_C (millions)	2,303.43	.62[d]	2.01	.65	.65	98.66	2.37[d]	54.91	5.79	5.79
Domestic egg consumption, January–June, Q_E' (billions)	11.03	4.98	2.24	.20[d]	.31	.14	438.14	221.29	29.2	7.21[d]
Net into storage movement, January–June, S' (billions)	8.03	6.75	3.09	.36[d]	.36[d]	.14	438.14	221.29	66.14[d]	66.14[d]
Retail price, per dozen, P_R (cents)	395.85	.44	1.27	.29[d]	.61	11.05	2.59	45.30	1.65[d]	6.52
Farm price, per dozen, P_F (cents)	407.12	.54	1.11	.44[d]	.66	16.93	1.92	20.31	1.62[d]	4.98
Retail price, per dozen, January–June, P_R' (cents)	617.24	.64	.48	.37[d]	.48	82.59	16.97	1.40	1.22[d]	1.59
Farm price, per dozen, January–June, P_F' (cents)	526.09	.76	.62	.40[d]	.54	85.85	1.33	1.28	1.24[d]	1.68

[a] Models fitted to first difference values for the years 1932–41 plus 1947–54.
[b] Unexplained variation computed as the sum of the squared differences in each year between the year-to-year changes for a variable and its value estimated by specified model and method of fit. Total variation computed as the sum of the squared differences in each year of the year-to-year changes for a variable.
[c] Least squares equations were not fitted for this variable.
[d] Signifies estimate for which ratio of unexplained variation to total variation is smallest for the specified variable.

TABLE 6. VARIABLES IN THE EGG ECONOMY: PERCENTAGE DIFFERENCES BETWEEN ACTUAL AND ESTIMATED VALUES OBTAINED FROM ALTERNATIVE MODELS AND METHODS OF FIT, 1955–57[a]

Variable	1955				1956				1957			
	Simultaneous approach		Least squares		Simultaneous approach		Least squares		Simultaneous approach		Least squares	
	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II	Model I	Model II
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Domestic egg consumption, Q_E	0.7*	11.6	3.8	1.7	− 1.8*	2.3	4.6	2.5	2.0*	14.1	2.2	5.6
Farm egg production, Q_F	.0*	11.1	3.5	1.3	− 2.0*	2.1	4.4	2.3	1.8*	13.9	2.2	5.6
Layers on farms, L_F	− 1.1*	2.7	—[b]	—[b]	− 2.9*	6.2	—[b]	—[b]	.3*	.3*	—[b]	—[b]
Pullets raised, January–June, C_F	− 6.6*	12.4	8.3	8.3	− 3.2	−1.0*	2.0	2.0	− 4.5	10.9	−1.2*	−1.2*
Layers sold, L_C	− .9*	26.6	5.6	5.6	− 1.5	2.1	—[c]	—[c]	− 6.6*	18.7	−9.1	−9.1
Domestic egg consumption, January–June, Q_E'	18.0	15.0	6.0	2.7*	14.0	−2.3	2.9	− .3*	−11.9	10.3	− .6*	1.9
Retail price, per dozen, P_R	− 8.4	−33.4	−2.9*	−5.0	− .9*	−3.1	3.6	1.9	3.8*	−20.0	6.0	14.4
Farm price, per dozen, P_F	−12.6	−43.4	−4.9*	−7.9	− .5*	−4.1	4.9	2.3	8.2*	−22.4	12.8	24.4
Retail price, per dozen, January–June, P_R'	59.6	4.1*	12.6	6.5	31.7	−5.7	−.2*	−5.7	−11.6*	20.3	15.0	21.1
Farm price, per dozen, January–June, P_F'	−26.8	5.3*	18.2	9.5	−11.6	−8.8	−.8*	−8.5	− 2.3*	31.6	26.6	35.8

[a] Models fitted to first difference values for the years 1931–41 plus 1947–54.
[b] Least squares equations were not fitted for this variable.
[c] Less than 0.05 per cent.
* Signifies the smallest percentage difference between actual and estimated values of each variable in each year. Computations not shown for net nto storage movement, January–June, S′, as estimated values included many stock reductions while actual storage movement in each year increased stocks.

mated value of the endogenous variables in the model is obtained as a weighted linear combination of all the predetermined variables in the model. It would appear that the greater the number of relevant predetermined variables used in a model, the smaller the difference between the estimated value and the actual value of an endogenous variable because more information about the economic system is being utilized.

In fitting the egg model, the addition of certain predetermined variables to the model increased the degree of correlation among the predetermined variables. While the exact effect of high intercorrelation among the predetermined variables in a simultaneous approach is not measurable, it appears, from considering the effect on a least squares solution, to contribute to larger standard errors of the regression coefficients than if the intercorrelation were not present. However, as long as the values of the predetermined variables in the model stay within, or close to, their range of values during the period for which the model was fitted, the effect of high intercorrelation among the predetermined variables on the estimated values of the endogenous variables apparently is minimized. As the values for 1955-57 of the predetermined variables in the model of the egg economy are within, or close to, their range of values for the 1932-41 plus 1947-54 period, estimated values of the endogenous variables from both the simultaneous approach and least squares fits of model I are closer to the actual values of the endogenous variables than the estimates derived from the simultaneous approach and least squares fits of model II. However, if the values of the predetermined variables should depart widely from their previous levels, model II, which had smaller standard errors of the regression coefficients, would probably give better estimates than model I, although the former uses less information.

An additional consideration in appraising the results of an analysis is to determine the independence of the residuals of the fitted equations. If the assumption does not hold that the residuals are independent, then the estimators of the parameters in the system are not efficient and the confidence regions calculated without taking the serial correlation into account may be highly misleading. The results of the test for independence in the residuals from model I and model II, fitted by the simultaneous approach, were inconclusive. Therefore, in using the results from the analyses in this paper, it should be kept in mind that some limitations are involved in the confidence regions of the elasticity coefficients.

Conclusions

This paper presents a series of behavior relations and identities which are believed to simulate the basic economic system for the egg industry. Measures of the more important elasticities in the system are presented and compared with elasticities obtained by other researchers. As elasticity

measurements in this paper were obtained from several models and methods of fit, indications are given of the elasticities which appear to be the most reasonable from both economic and statistical criteria.

In using the equations fitted by both approaches to forecast values of variables in the egg industry beyond the years for which the equations were fitted, better estimates of the annual quantity variables (domestic egg consumption, egg production on farms, average number of layers on farms, and number of layers sold) appear to be obtained from the simultaneous approach, while better estimates of the January-June quantity variables (domestic egg consumption, January-June; net into storage movement, January-June) and the price variables (annual retail price, annual farm price, January-June retail price, January-June farm price) appear to be obtained by the least squares method.

The above results in relation to making a uniform decision as to the merits of models fitted by least squares and limited information methods, I believe, leaves us in the position of Boulding's friend:

> Below the stars, above the mud
> Man seeks to find his Highest Good—
> He's partly trader, partly hero:
> Between infinity and zero,
> He occupies a middle place,
> One foot in Sin, and one in Grace—[4]

However, I hope that the results have given us more of the "why"—useful knowledge—about the egg industry.

Literature Cited

(1) Fisher, Malcolm R.
1958. A Sector Model—the Poultry Industry of the U.S.A. *Econometrica.* 26:37-66.

(2) Fox, Karl A.
1953. The Analysis of Demand for Farm Products. *U. S. Dept. Agr. Tech. Bull. 1081.* 90 pp., illus.

(3) Judge, George G.
1954. Econometric Analysis of the Demand and Supply Relationships for Eggs. *Conn. (Storrs) Agr. Expt. Sta. Bull. 307.* 56 pp., illus.

(4) Nordin, J. A., Judge, George G., and Wahby, Omar
1954. Application of Econometric Procedures to the Demands for Agricultural Products. *Iowa Agr. Expt. Sta. Research Bull. 410,* 56 pp.

[4] Kenneth Boulding, *The Skills of the Economist,* Cleveland, 1958. p. 160.

DISCUSSION: LINEAR PROGRAMMING MODELS FOR THE DETERMINATION OF PALATABLE HUMAN DIETS

DAVID R. PERYAM
Quartermaster Food and Container Institute for the Armed Forces

I am highly appreciative of what Smith has accomplished and the ideas he has contributed in his paper. My praise is qualified to some extent in that I am neither a mathematician nor a statistician, but a psychologist whose concern is with human behavior as it relates to food, i.e., with food acceptance. Linear programming itself I understand only generally, i.e., in terms of inputs and outputs and general ideas about the assumptions involved. Thus, I am hardly qualified to evaluate Smith's models from the technical standpoint. Their adequacy in this regard I shall assume, and leave judgment to his peers in the statistics field. But I do feel qualified to evaluate what he has done in light of what he attempted and for its general significance. And this I find not just good, but even fascinating.

There is great variability in the way humans satisfy their appetites and keep themselves "nutritioned." Man is omnivorous; not only his stomach, but also his tastes, are broadly adaptable. Particularly in a culture and an economy such as ours, the diet can be made up in many different ways because of the many different foods available and the wide range of most people's eating habits. As Smith pointed out, food choices in this situation may be influenced by many interacting forces, some of which are difficult to understand, and, of course, to measure—so many in fact, that it is easy to conclude that actual diets are purely adventitious. Smith has sought to impose a degree of order within this complexity, simultaneously recognizing the importance of known, objective requirements and of a group of the intangible requirements. In my opinion his attempt has met with gratifying success.

After I received the paper last week it was read by several members of the staff of our Food Acceptance branch at the Institute. Then we started swapping views, opinions and ideas. Enthusiasm grew as we concluded, progressively: first, that Smith had seized upon something significant; second, that it was interesting and challenging in its own right; and finally, that his approach might be very useful to us. Now we are at the point of paying him the ultimate compliment of stealing his model almost *en toto*. I should like to tell you about some of our ideas, showing how we think Smith's approach could apply to our problems. In so doing, I believe we will further demonstrate the value of his models.

The problem Smith accepted was to minimize the cost of the diet under known restrictions imposed by nutritional needs plus others, less

well known, imposed by people's habits, customs, preferences, etc. Underlying the Quartermaster's day-to-day research on acceptance problems related to feeding the Armed Forces, we at the Institute have recognized a long-range objective. What we are attempting to do is to maximize probable acceptance (which we may call preference) under a set of restrictions which includes the two familiar ones of nutrition and cost, plus some others, not so clearly defined, which we call logistical considerations. In our present thinking we have disregarded the latter because we do not know how they might be handled, but the rest of our problem, we believe, could be set into a linear program model by a relatively simple extension of Smith's approach.

Smith used his model to minimize one variable—cost. I am assuming that the linear programming method can serve just as well to maximize another variable, preference, if we can get it in the equation. If that is true, then the only new thing, essentially, is that we propose to become much more positive and rigorous about Smith's "conventional" restrictions. The diets provided by Stigler's solution or by Smith's simpler models are merely curios; no one would use them, at least not in this country. Habit, custom, preference for flavor, traditional ideas of what is fitting in the way of a meal—in a word, acceptability—demand consideration. Smith does this by providing a broad range of commodities, by his complementary restraints, and by setting minimum and maximum limits on the amount of certain commodities. Obviously, he achieved a degree of success. The commodity list from the large model could provide menus recognizable as such. The approach of selecting only from among those items which are used by 50 per cent of the population goes a long way toward taking care of palatability. Of course, actual usage of food is determined, in part, by factors other than preference or palatability, e.g., price, availability, sound and "faddish" nutritional ideas, and many others. Thus, there is some confounding with other things, even though usage is a fairly good criterion of acceptability. But I think we have a better one.

There are a number of considerations involved in shifting to the more positive and independent approach to palatability which I have promised. Let me go through them briefly.

(1) We need a quantitative measure of preference. This can be provided through use of the 9-point "like-dislike" rating scale (hedonic scale) developed by the Institute which is now widely used in food research. The preference measure would be the mean value assignd to an item by a fairly large sample of the population.

(2) Often, or usually, it is meaningless to talk about preference for a commodity, such as flour, salt, beef, potatoes, or vinegar, because commodities can take many different forms before consumption. Meaningful,

reliable preference attitudes are associated only with the final forms. Therefore the items from which selection is made, the *n*'s, will have to be what we call "dishes," e.g., white bread, Devil's food cake, beef stew, hamburgers, lettuce with French dressing, hominy grits, and hundreds of others.

(3) This requires some changes in the method of determining quantity of food. We propose the unit of a "normal serving" which, of course, would vary with the dish under consideration. For example, a normal serving of hamburger might be 8 ounces, of cake—6 cubic inches, of coffee —1 pint, etc. These amounts should be as near those customarily served as possible, although it would do little harm in the long run to be arbitrary. Both cost and nutritional values could be computed on this normal serving basis by simple arithmetic from the same information one would use to compute on a per pound basis.

(4) The initial preference rating described above does not express everything involved in acceptability; additional restraints will be necessary. One such will be a limit on the frequency with which a given dish can be used. Studies being run by the Institute show that such limits exist, and that by using survey methods they can be estimated (approximately) in terms of the number of servings desired per month.

(5) Another concept to consider is what we call "menu function." No matter how much one might like desserts, he wouldn't want a meal composed entirely of them. Usual menus will contain dishes in at least three or four of the following classes: beverages, main dishes (usually meats), vegetables, starches, soups, desserts, and salads. Our model will have to recognize this convention.

(6) There is the concept of the suitability of a dish to a given meal. For example, one wouldn't want to have to eat corn flakes for dinner or supper very often, or even beef steak for breakfast (unless he first milks 25 cows each morning), as he might have to do unless we apply some kind of control.

(7) A final acceptability consideration is that of menu combinations. In what I propose, we shall assume that the preferences for dishes are additive, i.e., that the acceptability of any menu could be predicted from simple combination of the preference ratings for the individual dishes; also, that the "amount of preference" contributed by an item is the same in all cases. This tends to be the case, but we know from research done at the Institute, if not from simple intuition, that there are important exceptions. A homely example is found in sweet potatoes, which is generally a low preference item, but makes a high preference combination with baked ham. But how these combination effects could be included in the model so far has exceeded the power even of our speculation. Therefore they have been disregarded.

The n's to be fed into the model will then be a large number of dishes. The solution will come out in terms of the number of servings of each dish that should be provided for each man for a one-month period. I would guess that the wider the range of dishes, the better. We need not worry too much about how often they are actually being used by the population under consideration since, if the dishes are unfamiliar, they will also tend to be disliked. Perhaps some could be eliminated on the basis of known low preference; however, this also should be automatically taken care of by the system.

For each dish the following information would be needed: amount of a normal serving, cost of a serving, amount of each nutrient in a serving, preference value of the dish on the hedonic scale, its maximum safe frequency of serving, the meal, or meals, to which it is appropriate (breakfast, dinner, or supper), and, finally, its menu function (soup, main dish, salad, or other).

The restrictions, the m's, to be imposed would be: (1) nutritional—just as in Smith's model; (2) cost—a predetermined figure per man for the month; (This is actually the way the cost of the ration is budgeted in the Armed Services. Also this is probably the most common approach used by the cost-conscious housewife.) (3) frequency—for each dish a fixed maximum number of times it can appear during the month; (4) menu function—a fixed minimum number of different dishes of most (if not all) of the various menu types. For example, one might require at least four beverages, three soups, 15 main dishes, five salads, 10 vegetables, and so on. Decisions made here would, of course, be important for assuring over-all variety in the diet.

I will end my discussion with a question. Would it not be possible to adapt this revised model to the problem of minimizing the cost of diets of pre-selected palatability levels? I suggest that this could be done by constructing an index of minimum preference and substituting it for the cost restraint. Cost would then become the variable.

There it is. It sounds simple, but, of course, in describing it I have taken advantage of the fact that Smith has already explained the complexities. Would it work? You will note that there would be a lot of details to be worked out, and many arbitrary decisions to be made, but I believe that the approach would provide much useful information; and, may I add, when we try it, it will be with many thanks to Smith and to the American Farm Economic Association for bringing his work to our attention.

DISCUSSION: ECONOMETRIC MODELS IN AGRICULTURE

CHARLES J. ZWICK
The RAND Corporation

As Smith pointed out, economists have been singularly unsuccessful in applying linear programming techniques to determine acceptable minimum-cost diets. Smith's work is a first attempt at filling this void. It seems to me that there are two questions that should be asked of it: First, what would we do with these solutions if, in fact, we can obtain them? Second, do the procedures employed lead to operationally useful results?

Smith argues that such models are, in fact, useful. To quote him:

"Such models can be of great assistance to dieticians and to all persons concerned with advice to consumers, institutional feedings, or meeting the nutritional requirements of the impoverished throughout the world. In addition, such models can be fruitful bases for economical analysis of problems of consumer choice."[1]

I wish Smith had elaborated on his last point, i.e., that such models can be fruitful bases for economical analysis of problems of consumer choice. Although I have given very little thought to this general problem, the uses Smith alludes to are not obvious to me.

If it is possible to construct an index of palatability, will it be of some use to persons concerned with advice to consumers? Here I would be less optimistic than Smith. Surely we would need more than one average index—perhaps hundreds of them representing the preferences of homogeneous subgroups within our population. Although I have never seen an attempt to aggregate consumers into these homogeneous subgroups, I have seen the equivalent tried in the case of farms. For example, economists at the University of Connecticut tried to organize the farms in that state into a large number of homogeneous groupings, arguing that if this were possible they then could derive optimum programs or budgets for all farms within the class—something very analogous to what Smith is suggesting for consumers. In the case of Connecticut farms, the subgroups became smaller and smaller in size and larger and larger in number, and eventually the work was put away in several file cabinets. I have a suspicion that the same sort of thing would happen if we tried to classify consumers into homogeneous subgroups. Or, stating it another way, an average index of palatability is of little value in making suggestions to individual consumers as to how they should allocate their budget. The only alternative then is to break the population down into groups which are homogeneous with respect to their preferences for food.

Smith also argues that the models would be of value to persons con-

[1] This paragraph is from an early draft given the discussant by Smith.

cerned with institutional feeding. Here I agree with him. If it is possible to construct an average index of palatability for the population served by an institution, it then should be possible to use this index to construct a minimum cost diet.

In sum, I see a much more limited applicability for these models than Smith, and can only wish that he had expanded on this section of the paper.

Turning to the second question, i.e., can one, in fact, construct an index of palatability, I can only comment that this is indeed a difficult task and Smith seems to be well aware of this in his carefully worded treatment. Essentially, his approach was to use data collected from a consumer panel, concluding that those items purchased by a significant part of the sample were in some sense palatable. This approach has, of course, several problems associated with it. For example, actual purchases represent a maximizing process on the part of consumers, and it is not valid to conclude that items not purchased were not palatable. Commodities not purchased may have been palatable, but they might also have been rejected because they were inferior alternatives, given the price and income situation. In short, observing items not purchased and inferring that these are unpalatable items eliminates a large number of items which might become significant purchases given a major change in relative prices. For example, anyone observing my purchases will find filet mignon showing up quite infrequently. I would, in fact, become quite disturbed with an advisor who did not advise me to buy filet mignon when its price had dropped to one-half its current level, assuming, of course, all other prices constant.

On the institutional feeding problem, alternative methods of estimating an index of palatability seem possible. For example, a university dining hall could run experiments and attempt to define preference indexes among items within particular subgroups of foods. Given this information, it would then be possible to apply the linear programming technique.

I would encourage continued work in this area. For some reason, we have been less successful in helping consumers make better budget allocations than economists have in the field of production economics. Certainly it should be possible to say more than "potatoes are a good buy this week."

Turning to Gerra's paper, I must confess that his opening remarks completely disarmed me and I find it difficult to say anything adverse about his paper. I quote Gerra:

> "In much of the recent discussion on the appropriate method of statistical estimation to be used in fitting economic models, I cannot help but feel that we have somewhat lost sight of the 'what' and 'why' of economic models while concentrating on the 'how.' In this report I shall concentrate on the 'what' and 'why,' and only briefly touch on the 'how.' "

To this I can only add that I second the motion. When a group of econometricians get together there is a tendency to get involved in rather elaborate debates as to which technique is preferred with little regard to how the techniques are going to be employed. In such debates I always feel at a loss because techniques by themselves are amoral and are only good or bad relative to particular applications.

In sum, I can only hope that Gerra's decision to concentrate on the "what" and "why" of the problem starts a trend in the profession.

The reported analysis does provide additional insight into the underlying economic structure of the egg industry and, as such, adds to the earlier works of Fox, Judge, *et al.* In particular, I thought the introduction of intra-year price movements and their effect on production decisions was valuable. The quantitative results obtained are, in general, quite consistent with the earlier works. Unfortunately, they also contain the same uncertainty about their true values as was the case in earlier studies.

Whether or not these estimates do, in fact, provide us with "useful knowledge" depends upon what sorts of questions one would like to answer. Clearly there is a large number of questions for which the precision that these estimates provide is sufficient. On the other hand, one can think of other questions on which one would like to have more precision. In this regard I thought the example Gerra chose to demonstrate the usefulness of in his model was inappropriate. He considered a farmer who was making an investment decision. To make the investment decision a producer must know something about future prices. The model Gerra presented obviously does not help him since it was concerned with determining the short-run results of a set of market interactions. To be helpful in the process of investment, a model must be able to predict future prices. In short, the long-run prediction problem requires a different model. Such a model would include the more traditional variables—changes in population, national income, and so forth—and also an index of technological change. It is clear that, in the past, technological change in the poultry industry has had a bigger impact on egg prices than national income and population changes.

To summarize, I feel Gerra has provided some interesting and worthwhile insights into the egg economy and has made a significant contribution. Like any economic model, his will not answer all the salient questions about the egg industry, but Gerra did not claim this quality for it. And finally, I would like to salute him for concentrating on the "what" and "why" parts of the problem rather than on the "how" side.

AGRICULTURAL OUTPUT AND THE DEMAND FOR INPUTS

Chairman: Clifford Holdreth, Michigan State University

THE DEMAND FOR INPUTS IN AGRICULTURE AND A DERIVED SUPPLY ELASTICITY

ZVI GRILICHES
University of Chicago

Introduction

THIS paper is divided into two unequal parts. The first part is a summary of a series of more detailed reports dealing with the estimation of demand functions for selected farm inputs (fertilizer, tractors, and hired labor).[1] The second and shorter part of this paper illustrates the possible relevance of these results for supply analysis by deriving, with the aid of considerable guesswork, the supply elasticity implied by the estimated input demand elasticities.

The Demand for Inputs in U. S. Agriculture

The framework of the studies

While the structure of agricultural factor markets is of great interest to the agricultural economist, very little is know quantitatively about them. Except for the inputs that are also outputs of the agricultural sector, there are almost no published studies of the demand for specific inputs, and except for migration studies, nothing is known about the supply functions of agricultural inputs.

The studies summarized in the following sections were designed to fill some of this gap.[2] Only three inputs are covered in this summary: fertilizer, tractors, and hired labor, and the analysis of the demand for hired

---

[1] These reports are all part of a more general study of changing inputs in U. S. agriculture which is being supported by a National Science Foundation grant.

[2] The void must have become apparent at several places at about the same time. Besides my own work in this area I am aware of the work of Yeh and Heady on fertilizer demand (see M. H. Yeh and E. O. Heady, "Fertilizer Demand Functions for the U. S. and Selected Regions," A Progress Report Presented at the TVA Conference, Knoxville, March 25-28, 1958), and the work of Cromarty, Fettig, and Hathaway on the demand for farm machinery (see W. A. Cromarty, *The Demand for Farm Machinery and Tractors,* Michigan State Agricultural Experiment Station Technical Bulletin, in press; L. P. Fettig, "Purchases of New Farm Tractors and Machinery in Relation to the Non-farm Business Cycle, 1910-1956," Michigan State University unpublished M.S. thesis; and D. E. Hathaway, "Agriculture and The Business Cycles," *A Policy for Commercial Agriculture,* U. S. Congress, Joint Economic Committee, November 22, 1957). At the time of writing, most of this work was still unpublished. To the extent that I have had access to some of the preliminary materials, they do not appear to be inconsistent with the results presented.

farm labor is highly tentative. Except for the fertilizer studies, where the analysis was pursued also on a regional basis, on a commodity basis, and on a cross-sectional basis, all of the other studies are limited to an analysis of aggregate U.S. time series. They all have a common theoretical and statistical framework. The demand for a factor is treated as a derived demand, derived from the demand for the product, the production function, and the supply conditions of other factors of production. The desired level of use of any one factor is assumed to depend on the expected price of products, the price of the factor, the prices of other factors, and in the case of durable goods, the rate of interest. The actual level of use, however, is not assumed to equal the desired level except in the long run. The realization that price changes may not be expected to be permanent and that adjustments are not costless and take time leads to the use of a distributed lag model, a model that allows the adjustment to changes in the various independent variables to be spread over more than just one year.[3]

Detailed descriptions of the models, definitions of variables, sources of data, and discussions of the limitations of the resulting estimates are given in the original reports and will not be repeated here. I would like, however, to comment briefly on the absence of farm income in these demand equations. There is no good theoretical reason for including income in the demand equation for a factor. At least it is not derivable from the traditional theory of the firm.[4] Income is usually introduced as a proxy for two other variables: "expectations" and "liquidity." Prices surely are more relevant for the measurement of expectations, and income, as conventionally measured, may have very little to do with "liquidity."[5] I think that

---

[3] For a detailed exposition of such models see M. Nerlove, *Distributed Lags and Demands Analysis of Agricultural and Other Commodities,* Washington: USDA Agriculture Handbook, No. 141, June, 1958. The model can be summarized as follows:

(1) $$y^*_t = f(p_t)$$

where y^* is the "desired" level of use, p stands for a vector of all relevant prices, and the coefficients of $f(p_t)$ are interpreted as the "long run" coefficients.

(2) $$y_t - y_{t-1} = b\,(y^*_t - y_{t-1})$$

This is the adjustment equation which implies that the actual change in the level of y is proportional to the difference between the currently "desired" level and the previously achieved level. The adjustment coefficient is b. An estimate of b close to one implies almost immediate adjustment, a low b implies a very slow adjustment to changes in p. Substituting (1) into (2) and solving for y yields

(3) $$y_t = bf(p_t) + (1 - b)\,y_{t-1}$$

where the coefficients of $bf(p_t)$ are interpreted as the "short-run" coefficients. This general form underlies almost all of the estimates presented below. All the coefficients to be presented below were estimated using straightforward least squares procedures. No attempt has been made, as yet to apply simultaneous equation techniques to these models.

[4] On this point see G. W. Ladd, "Farm Income and the Supply of Agricultural Products," *Journal of Farm Economics,* November, 1957.

[5] For an excellent discussion of some of these same issues in a different context see Y. Grunfeld, "The Determinants of Corporate Investment," unpublished University of Chicago Ph.D. thesis, 1958.

we can and should try to measure these factors directly instead of introducing proxy variables that are very difficult to interpret. Also, while high farm expenditure-farm income correlations were obtained in the 1930's and 1940's, most of them fell apart in the 1950's.

The demand for fertilizer

The model used assumes that current plant nutrient consumption is a function of the "real" price of fertilizer, i.e., the price paid per plant nutrient unit relative to the prices received for farm crops, the prices of other factors of production, and lagged plant nutrient consumption. Table 1 presents a summary of the major results of an aggregate U. S. time series study, a study of the time series for nine census regions, a study of the time series on the use of fertilizer on cotton in the United States and in Mississippi, and a cross-sectional study of fertilizer use in 45 states in 1954. The table presents the estimated short-run and long-run demand elasticities with respect to the "real" price of fertilizer, the estimated adjustment coefficients, and the squared multiple correlation coefficients. Lines 1 through 5 report on studies containing only two independent variables: "real" price and lagged fertilizer use. An attempt to improve upon these results through the introduction of the price of farm labor and the prices of other factors of production as additional explanatory variables was unsuccessful at the aggregate U. S. level. The prices paid for other inputs did, however, contribute significantly to the explanation of the variations in fertilizer use on cotton per cotton acre (lines 6 and 8 in Table 1). While it was difficult to disentangle the relative importance of changes in other factor prices in the aggregate time series study, at the cross-sectional level (line 9, Table 1) the price of labor and the price of land appear to be important in explaining interstate variability in plant nutrient use per acre, indicating that land is a substitute for and labor is a complement to fertilizer. Very high fits were obtained in almost all of these equations.[6]

The evidence presented in lines 3-9 is quite consistent with the previous estimates of the "real" price elasticity of the farm demand for fertilizer as approximately -0.5 in the short run and -2.0 in the long run, the adjustment coefficient being around 0.25. The nine regional estimates bracket the aggregate U. S. estimates with the "new" fertilizer regions having lower adjustment coefficients and higher price elasticities than the "old" fertilizer regions. That is, a given percentage drop in the real price of fertilizer will result ultimately in a larger relative increase in fertilizer

[6] It is not surprising that the use of the lagged dependent variable as an additional independent variable results in high coefficients of multiple correlation. A more relevant measure of success may be the partial contribution of the other variables, their "significance." The coefficients of "real" price in Table 1 and in the subsequent tables are all significantly different from zero at the conventional significance levels.

TABLE 1. ESTIMATED ELASTICITIES OF THE FARM DEMAND FOR PLANT NUTRIENTS

Period and Coverage	Dependent Variable	Elasticities of Demand with respect to the "real" price of fertilizer		Adjustment Coefficients	R^2
		Short-run	Long-run		
1. United States: 1911–56	Y	−.54	−2.3	.23	.98
2. United States: 1911–56	Y_A	−.53	−2.2	.24	.98
3. United States: 1931–56	Y_{WA}	−.39	−2.1	.18	.98
4. Nine Census Regions: 1931–56	Y_{WA}	−.13 to −.78	−1.3 to −5.0	.10 to .28	.95 to .99
5. United States: 1922–53	Y_{cotton}	−.45	−1.1	.43	.78
6. United States: 1922–53	$Y_{cotton}/_A$	−.18	−0.6	.31	.93
7. Mississippi: 1922–53	Y_{cotton}	−.42	−1.1	.38	.84
8. Mississippi: 1922–53	$Y_{cotton}/_A$	−.29	−0.8	.34	.91
9. Cross-section 45 states: 1954	Y_{WA}	−.84	−0.8[a]	—	.89

[a] No distinction between short and long run in the cross-sectional model. It did not use the distributed lag model.

All variables were expressed as logarithms of the original values.

Dependent variable:

Y—total plant nutrients.

Y_A—total plant nutrients per acre of cropland used for crops.

Y_{WA}—price weighted plant nutrients used per acre of cropland used for crops (per acre of cropland harvested and improved pasture in 9).

Y_{cotton}—plant nutrients used on cotton.

$Y_{cotton}/_A$—plant nutrients used on cotton per acre of cotton.

"Real" price—Price paid per plant nutrient unit divided by index of prices received for products (all crops in 1–4, cotton in 5–8, value of crops produced per acre of cropland in 9).

References:

1 –2 Zvi Griliches, "The Demand for Fertilizer: An Economic Interpretation of a Technical Change," *Journal of Farm Economics*, XL (3), August 1958.

3 –4 Zvi Griliches, "Distributed Lags, Disaggregation, and Regional Demand Functions for Fertilizer," *Journal of Farm Economics*, February, 1959.

5 –8 Zvi Griliches, "The Demand for an Input: Plant Nutrients Used on Cotton, 1923–1953," unpublished.

9 Zvi Griliches, "The Demand for Fertilizer in 1954: An Inter-State Study," *Journal of American Statistical Association*, June, 1959.

Equations 6–8 contain also an additional variable: the price paid per plant nutrient unit divided by an index of prices paid for commodities and services used in production. Hence the total elasticity with respect to the absolute price of fertilizer is different from that indicated in the table. The short-run "total" price elasticity is −.64 in (6), and −.67 in (7), and −.87 in (8).

Similarly (9) contains also the price of fertilizer relative to cash farm wage, the price of fertilizer relative to the cash rent paid per acre, and the average nitrogen content of soil. The estimated "total" fertilizer price elasticity is −.46.

use in the "new" fertilizer regions (the Midwest and the West) than in the "old" regions (the South), but the "old" regions will react faster to the same price change. The results of the cotton fertilizer studies are in the same direction. As one would expect for a well-established use of this particular input, the long-run price elasticity of cotton fertilizer is lower than the aggregate U. S. fertilizer price elasticity, indicating that, in some sense, fertilizer use is closer to its "ceiling" in cotton than it is in other crops. The ad-

justment coefficient for cotton fertilizer, however, is higher than the adjustment coefficient for all fertilizer, indicating a faster response to price changes in this well-established area of fertilizer use. Also, as was to be expected, the cross-sectional estimate of the price elasticity which does not utilize a distributed lag model falls between the short run and long run elasticity estimates from the time series data.

An interesting implication emerges from a comparison of the price elasticities given in lines 5 and 7 with those in 6 and 8, a comparison of the price elasticity of total fertilizer used on cotton with the price elasticity of fertilizer used per cotton acre. It can be easily shown that the difference between these two elasticities should equal the price elasticity of cotton acres, or in other words, the supply elasticity of cotton acres.[7] For the U. S. the implied supply elasticity of cotton acres is about .3 in the short run and .5 in the long run. This is very close to Nerlove's estimates of these same elasticities (.34 and .67).[8] For Mississippi the implied supply elasticities are .13 and .30, respectively, indicating that the supply elasticity of cotton acres in an old cotton state is lower than it is for the U. S. as a whole.

The farm demand for tractors

The model used to estimate the demand for tractors is similar to the fertilizer model except for the consideration that tractors are durable goods. Two modifications follow from this: (1) The basic demand is for a stock of tractors, not for a flow of purchases. If we want to explain purchases we need to derive the "investment function" from the demand function for the stock of the particular capital item. (2) The rate of interest becomes one of the important variables in the model. Table 2 summarizes the results of the tractor demand study. It presents estimates of stock elasticities based on two alternative approaches: (1) a stock

---

[7] This can be shown as follows:

$$Q = F \cdot A \tag{1}$$

where Q is total fertilizer used on cotton, F is the quantity of fertilizer used per cotton acre and A is the number of acres devoted to cotton.

$$\frac{dQ}{dp} = \frac{dF}{dp} \cdot A + \frac{dA}{dp} \cdot F \tag{2}$$

$$\frac{dQ}{dp}\,\frac{p}{FA} = \frac{dF}{dp}\,\frac{p}{F} + \frac{dA}{dp}\,\frac{p}{A} \tag{3}$$

The left-hand side of (3) is the price elasticity of total fertilizer used on cotton. The first term on the right-hand side is the price elasticity of fertilizer per cotton acre and the second term is the price elasticity of cotton acres.

[8] See M. Nerlove, "Estimates of the Elasticities of Supply of Selected Agricultural Commodities," *Journal of Farm Economics*, May, 1956, p. 505.

demand function relating current stock to past prices, rate of interest and lagged stock, and (2) an investment function, relating purchases by farmers in constant dollars to current prices, rate of interest, beginning period stock.[9] Both models perform well in terms of fit, the signs of coefficients, and their statistical significance. The investment function provides a somewhat more powerful test of the model because it does not include a lagged dependent variable as one of its independent variables, and also because investment varies more than stock and hence there is "more to explain" there.

The indicated short-run "real" price elasticity of the demand for the *stock* of tractors is quite low, around–0.25. The long-run price elasticity is substantially higher, around −1.50, but the estimated adjustment coefficient (.17) is low, indicating that the "long run" may be rather far away.[10] The interest elasticity of stock is substantially higher than the price elasticity. This may be due either to the importance of general credit conditions in determining actual purchase levels, or to the poorness and sluggishness of the interest rate series resulting in an upward bias in its coefficient. One should note the similarity between the coefficients derived from the stock demand function and those derived from the investment function. Also, these coefficients were very little affected by the addition of other explanatory variables.

An attempt to improve upon these results by including the price of labor, the price of motor supplies, a time trend, a capital gains variable, the stock of horses and mules on farms, and alternative measures of the stock of tractors on farms were all unsuccessful.

While the stock price elasticities are low, this does not mean that a

[9] The two models are related as follows:

(1) $$S^*_{t+1} = f(X_t)$$

where S^*_{t+1} is the desired level of stock and X_t is a vector of independent variables.

(2) $$S_{t+1} - S_t = b(S^*_{t+1} - S_t)$$

where b is the adjustment coefficient. But also

(3) $$S_{t+1} = I_t + (1 - d)S_t$$

where I_t is gross investment during the year and d is the rate of depreciation. Now (1) and (2) lead to

(4) $$S_{t+1} = bf(X_t) + (1 - b)S_t$$

which is the equation used in estimating the stock demand function. If, however, (3) is substituted into (4), the result is

(5) $$I_t = bf(X_t) + (d - b)\,S_t$$

the investment function. Equations (4) and (5) provide two almost equivalent ways of looking at the same thing except that for estimating purposes I assumed that (4) was linear in the logarithms of all the variables, whereas in (5) I kept the linear relationship between I_t and S_t, transforming only the variables in X_t into logarithms.

[10] An adjustment coefficient of .17 implies that it would take about four years to complete one-half of the indicated adjustment, and that at the end of eight years only about 78 per cent of the total adjustment will have been completed.

TABLE 2. ESTIMATED ELASTICITIES OF THE U. S. FARM DEMAND FOR THE STOCK OF TRACTORS

Dependent variable and form	Period	Elasticities with respect to "Real" Price of Tractors		Elasticities with respect to Rate of Interest		Adjustment Coefficients	R^2
		Short-Run	*Long-Run*	*Short-Run*	*Long-Run*		
(1) Stock; logarithmic	1921–41 1948–57	−.25	−1.5	−1.2	−6.9	.17	.994
(2) Gross Investment; Semi-logarithmic	1920–41 1947–57					.17	.905
At the mean		−.45	−2.6	−1.8	−10.3		
At 1957 levels		−.20	−1.2	−0.8	− 4.5		

Source: Zvi Griliches, "The Demand for a Durable Input: U. S. Farm Tractors, 1920–1957," *Studies in the Demand for Durable Goods*, A. C. Harberger, ed., Chicago: University of Chicago Press, forthcoming.

Note: Equation (1) relates the logarithm of stock to the logarithm of "real" price, the logarithm of the rate of interest, and the logarithm of lagged stock. Equation (2) relates the absolute value of gross investment in constant dollars to the logarithm of "real" price, the logarithm of the rate of interest, and the absolute value of stock at the beginning of the period.

Stock of tractors—value of the stock of tractors on farms, January 1, in 1935–39 dollars (unpublished USDA data).

Gross Farm Investment in Tractors—farm gross capital expenditures on tractors in 1935–39 dollars.

"Real" price of tractors—Index of prices paid for tractors divided by the index prices received for all crops.

Rate of interest—the farm mortgage interest rate.

The last two variables are lagged one year in equation (1).

given price change would have little effect on purchases. Actually, the *short-run* price elasticity of *investment* is −1.9 at the mean level of investment and −1.4 at the 1957 level of investment. That is, a 10 per cent rise in the relative price of tractors, or a 10 per cent drop in crop prices, would result, within the same year, in a 14 to 19 per cent drop in the demand for the output flow of the tractor industry. Even though the stock elasticities are small, they still imply large short-run fluctuations in gross investment.

The demand for hired farm labor

This is the most tentative section of the paper. It is based on an unpublished study by Lester G. Telser and some additional computations of my own.[11] While the results to be presented below are not unsatisfactory, they are preliminary in the sense that the model is still subject to revision and the data are very poor. In particular, the assumption that the wage of hired farm labor can be treated as predetermined is not very tenable

[11] L. G. Telser, "The Demand for Hired Farm Labor," unpublished manuscript, August 6, 1957.

and some simultaneous equation approach is probably called for.[12]

The model used for hired farm labor is identical with that used in the study of fertilizer demand. The quantity of hired farm labor is assumed to depend on the "real" price of hired labor (the wage paid divided by an index of prices received for all farm products), and lagged hired farm employment. Table 3 summarizes the results of two alternative sets

TABLE 3. THE U. S. DEMAND FOR HIRED FARM LABOR

Dependent variable and form	Period	Elasticity with respect to the "Real" Price of Farm Labor: Short-run, at the mean	Short-run, at 1956 levels	Long-run, at the mean	Long-run, at 1956 levels	Adjustment Coefficient	R^2
(1) Numbers Linear	1912–1956	−.52	−1.5	−.52[a]	−1.5[a]	1.00[a]	.91
(2) Numbers Linear	1912–1956	−.11	−.32	−.62	−1.7	.18	.98
(3) Value in constant dollars Logarithmic	1911–1956	−.10	−.10[b]	−.44	−.44[b]	.23	.92

[a] Assumed. No distinction between short and long run.
[b] Constant elasticities as a consequence of assuming a logarithmic relationship.
Source: L G. Telser, "The Demand for Hired Farm Labor," unpublished manuscript, August 6, 1957, and Zvi Griliches and Lester G. Telser, "The Demand for Hired Farm Labor," forthcoming.
Dependent variable: Numbers-Employment of hired farm workers. Value-Farmers Expenditures on hired labor in 1910–14 dollars (farmers' expenditures on hired labor divided by the USDA index of farm wages).
"Real" price of labor—Index of farm wages divided by the index of prices received for all farm products. In 1–2, index of wage rates is derived by dividing the expenditures by the numbers employed. In 3 it is the USDA index of farm wage rates.

of computations: lines (1)-(2) use numbers employed as the dependent variable and the ratio of expenditures to numbers as an estimate of wage rates. Line (3) reports on an estimate using expenditures on hired farm labor deflated by the USDA wage index as the dependent variable and the USDA wage index in the definition of the "real" price. Also (1)-(2) are estimated using linear equations, whereas (3) is based on an equation linear in the logarithms of the variables. There is little difference between these two approached. Both (2) and (3) indicate a short-run price elasticity of about −0.1 and a long-run price elasticity of −0.5 at the mean level of employment for the period as a whole, but the first set of estimates implies substantially higher elasticities at the 1956 level of hired farm employment. The introduction of the price of land and the price of

[12] George E. Schuh at the University of Chicago is currently investigating this problem.

tractors as additional explanatory variables did not result in an appreciable improvement upon the above reported results.

Other inputs, limitations, and reflections

Of all the other inputs, those that are also outputs of agriculture have been relatively well studied.[13] At the University of Chicago we are currently engaged in an over-all study of farm investment behavior with special reference to machinery purchases and service building construction. But the original attempt to cover all categories of inputs within the outlined model has been given up. This is a consequence of the paucity of data on many inputs and the realization that much of the published data is not really suited for an analysis of yearly changes. Much of the nonagricultural input data is based on semimechanical interpolations between benchmark years with little independent evidence on annual movements. This is particularly true of the "repairs and operation of capital equipment" categories and of various items in the "miscellaneous" category.[14] Also, to study adequately the farm demand for capital items, one needs estimates of the stock of these items on farms in some comparable units. The available stock figures are a by-product of farm depreciation estimates, and they, and the depreciation estimates themselves, are about the flimsiest set of official data perpetrated in agriculture. As far as I am concerned, the data problem in this area has become paramount and my interests have shifted towards the conceptual and practical problems involved in the measurement of capital inputs in agriculture.

The distributed lag model used in this paper deserves an additional comment. It has been performing extremely well throughout this set of studies, perhaps too well. That is, I do not believe that the theory is as good as the model makes it out to be. The reason why this model performs so well may be due to the fact that it takes care of almost all the mistakes that one can make by introducing the lagged value of the dependent variable as an additional explanatory variable. Therefore, one should take great care in interpreting its estimated coefficients. They

[13] For some of the feed and livestock results see the studies by R. J. Foote, *Statistical Analyses Relating to the Feed and Livestock Economy*, USDA Technical Bulletin No. 1070, June, 1953; and C. Hildreth and F. G. Jarrett, *A Statistical Study of Livestock Production and Marketing*, New York: J. Wiley & Sons, Cowles Commission Monograph No. 15, 1955.

[14] An additional example of data difficulties is provided by the estimated farmers' expenditures on hired labor. These are census benchmark figures moved annually by the product of hired farm employment and farm wage indexes. By the time a new bench mark becomes available, these estimates may be off by as much as 10-20 per cent. They are then "revised" by distributing the difference between the "predicted" level and the benchmark level evenly throughout the preceding period. This, of course, may obliterate most of the relevant annual variability in the data.

may measure more than just the "adjustment" or "expectation" process. They may actually take into account most of the variables that one should have included explicitly in the model but did not do so. This conclusion is supported by the general instability of the estimated adjustment coefficients in face of changes in the number of included variables or levels of aggregation.

In the November, 1958, issue of the *Journal of Farm Economics,* Nerlove and Addison have shown that if one leaves out the lagged dependent variable in a situation where the adjustment model is the correct one, this will produce serial correlation in the residuals and biased coefficients.[15] But the reverse may also be true. If the adjustment model is not applicable but there is nevertheless serial correlation in the "true" disturbances for other reasons, the introduction of a lagged dependent variable may increase the correlation coefficient, reduce the serial correlation, and produce significant adjustment coefficients, all for the wrong reasons. I would be the last person to deprecate the importance and usefulness of these models. I do want, however, to sound a note of caution about the interpretation of their results.[16]

A Derived Supply Elasticity

In the previous sections it was shown that agricultural inputs are responsive to changes in relative prices. But if inputs respond to price changes, so must also farm output. This is the basic idea underlying the assertion that a study of input behavior can also provide insights into the supply response of farm products.

It can be shown that any supply elasticity can be expressed as a weighted average of all the elasticities of demand for individual inputs with respect to the *price of the product.* If we assume that factors get paid the value of their marginal product, the appropriate weights are the factor shares. The aggregate supply elasticity can then be written as follows:

$$e_{qp} = \sum_{i} k_i \eta_{ip}$$

where e_{qp} is the supply elasticity of output q with respect to its own price p, k_i is the share of factor i in total costs or revenue, and η_{ip} is the elasticity of demand for factor i with respect to changes in the price of the

[15] M. Nerlove and W. Addison, "Statistical Estimation of Long-run Elasticities of Supply and Demand," *Journal of Farm Economics,* November, 1958.

[16] For some of these issues see the exchange between Brandow and Nerlove in the August, 1958, issue of the *Journal of Farm Economics,* and my "Distributed Lags, Disaggregation, and Regional Demand Functions for Fertilizer," *Journal of Farm Economics,* February, 1959.

product.[17] All this rests on the assumption that factor prices are given and fixed, i.e., that the supply of factors is infinitely elastic. I shall come back to this reservation in a moment.

All that is necessary then for an estimate of the aggregate supply elasticity of farm products are estimates of demand elasticities for all the inputs and estimates of their distributive shares. But that is a very big order. Most of the information is simply not available. Some progress, however, was made in the first part of this paper, and if one uses this information together with several "guesstimates" it may be possible to get an idea of the order of magnitude of the aggregate supply elasticity implied by these demand functions.

Assuming that the estimated fertilizer elasticity adequately represents the elasticity of the whole current expenditures category (excluding labor); that the total machinery demand elasticity is equal to the estimated tractor elasticity; that the demand elasticity for all farm labor is equal to the elasticity of the demand for hired labor; making a guess about the plausible values of the service building and inventories elasticities; assuming that the response of land to price changes is zero; and using two different sets of weights, we can calculate the implied aggregate supply elasticity of all farm products.

The results of these illustrative calculations are summarized in Table

---

[17] This can be shown most simply by assuming an aggregate production function and differentiating it with respect to the price of the product:

(1) $$Q = f(x_1, \cdots, x_n)$$

(2) $$\frac{dQ}{dP} = \frac{\partial Q}{\partial x_1}\cdot\frac{dx_1}{dP} + \cdots + \frac{\partial Q}{\partial x_n}\cdot\frac{dx_n}{dP}$$

Multiplying through by P/Q, we get

(3) $$e_{qp} = \frac{\partial Q}{\partial x_1}\,\frac{x_1}{Q}\cdot\frac{dx_1}{dP}\,\frac{P}{x_1} + \cdots + \frac{\partial Q}{\partial x_n}\,\frac{x_n}{Q}\cdot\frac{dx_n}{dP}\,\frac{P}{x_n}$$

That is,

(4) $$e_{qp} = \sum_i \cdot \partial_i \eta_{ip}$$

where a_i is the elasticity of output with respect to changes in factor i, and η_{ip} is the elasticity of demand for factor i with respect to the price of the product. Assuming perfect markets, the value of the marginal product of a factor will equal its price, and the elasticity of output with respect to factor i will equal that factor's distributive share. Hence we can substitute $k_i = \frac{P_iX_i}{pQ}$ for a_i and get the formula in the text.

This conclusion can be derived rigorously from the second order equilibrium conditions for a firm. On this see J. L. Mosak, "Interrelations of Production, Price, and Derived Demand," *Journal of Political Economy*, December, 1938, and J. R. Hicks, *Value and Capital*, 2nd ed., New York: Oxford University Press, 1956, Appendix to Chapter VIII.

4. The implied aggregate supply elasticity is about 0.30 in the short run and about 1.20 in the long run. Two very important limitations of these "estimates" should be borne in mind. First, these estimates are the result of a set of "illustrative" calculations. We do not have as yet the necessary information to do this right. I do believe that all the figures used are of the right order of magnitude, but some of them are based on very little evidence.

The second reservation is based on the assumption of constant factor prices (except land). These are estimates of the *partial* or *relative price* supply elasticity, the elasticity of the aggregate farm supply function with respect to product prices holding factor prices constant, or with respect to the relative (real) price of products, and not of the now popular *total* or *absolute price* supply elasticity. I do not believe that total

TABLE 4. ASSUMED ELASTICITIES OF THE DEMAND FOR MAJOR INPUT CATEGORIES IN U.S. AGRICULTURE WITH RESPECT TO THE PRICE OF AGRICULTURAL PRODUCTS, AND DERIVED AGGREGATE SUPPLY ELASTICITIES

Input	Elasticity with respect to product prices		Weights	
	Short-run	Long-run	(1)	(2)
1. Current Inputs	0.50	2.00	39.9	42.5
2. Machinery	0.25	1.50	10.5	19.5
3. Labor	0.10	0.50	28.1	18.7
4. Inventories	(0.25)[a]	(1.00)[a]	4.0	5.4
5. Buildings	(0.25)[a]	(1.00)[a]	6.6	3.4
6. Land	0.00[b]	0.00[b]	10.9	10.5
Implied aggregate farm supply elasticity				
		Short-run	.28	.30
		Long-run	1.20	1.32

[a] Pure guesses.
[b] Zero because the elasticity of supply is assumed to be zero, not because the elasticity of demand is zero.

(1) Based on the estimated fertilizer (Table 1, line 1) demand elasticities.
(2) Based on the estimated tractor demand elasticity (Table 2, line 1).
(3) Based on the estimated demand elasticity for hired farm labor (Table 3, lines 2 and 3).
(4) Pure guess. Consistent, however, with R. J. Foote's estimate of the short-run price elasticity of livestock units on farms (see Foote, *op. cit.*, p. 14).
(5) Pure guess. Consistent, however, with estimates of the non-farm housing demand elasticity. See R. F. Muth, "The Demand for Non-Farm Housing," in A. C. Harberger, ed., *op. cit.*
(6) Zero because a fixed supply does not allow one to observe a response to changing product prices.

Weights are from:
(1) Unpublished appendix to T. T. Stout and V. W. Ruttan, "Regional Patterns of Technological Changes in American Agriculture," *Journal of Farm Economics*, May, 1958; and
(2) Zvi Griliches, "Output over Input Indexes and the Measurement of Technological Change," unpublished University of Chicago Office of Agricultural Economics (dittoed) Research Paper No. 5819, Sept. 12, 1958.

elasticities, the elasticities of the reduced form equations, are a very useful tool unless one knows what goes into them. It is very important, however, to keep this distinction clear. If factor supply functions are not perfectly elastic within the relevant ranges, there will be a difference between these two concepts. Most of the statements about the unresponsiveness of aggregate farm output to price changes are based on the assumed short run inelasticity of factor supplies and refer, actually, to the *absolute* rather than the *relative* supply elasticity estimated in this paper.[18]

It would be interesting to know how much of a change in product prices translates itself into changes in factor prices. If factor supply elasticities were known, one could adjust each input demand elasticity in the formula by d/(d-a), where d is the supply elasticity of the factor and a is the elasticity of factor demand with respect to its own price.[19] Because this ratio is always smaller than one, the "total" supply elasticity with respect to the absolute price of products will be lower than the supply elasticity with respect to the "real" price of products. I do not feel that this reservation is very important in a full employment economy, but it could result in a reduction of about one-half in the estimated elasticities.[20]

The conclusion that emerges from this discussion is that a study of the demand for inputs may have also something to say about the supply

---

[18] E.g., D. Gale Johnson, "The Nature of the Supply Function for Agricultural Products," *American Economic Review*, September 1950.

[19] Consider a very simple model where

$$Q = W^a P^b \tag{1}$$

is the demand function for Q, and W is the price of Q, and P is the price of the product. The supply function of Q is given by

$$Q = W^d \tag{2}$$

Substituting (2) into (1) and solving for W we can get the following "reduced form":

$$W = P^{b/(d-a)} \tag{3}$$

and substituting (3) back into (1) leads to:

$$Q = {}^{b[d/(d-a)]} \tag{4}$$

where $b[d/(d-a)]$ is now the "total" elasticity of Q with respect to P.

[20] During the period 1920-1958 a 10 per cent change in the index of prices received by farmers for all farm products was associated with a 4.7 per cent change in the same direction in the index of prices paid by farmers for items used in production, wages, and interest. This statement is based on a correlation of first differences of the logarithms of these two indexes ($r^2 = .83$). Assuming that the elasticity of input demand with respect to the price of the factor is equal to minus the elasticity with respect to the price of the product, an assumption used throughout this paper, we would estimate the "total" or absolute elasticity of supply as $(1 - .47)$ times our estimated relative price elasticity. This adjustment probably overstates the flexibility of factor prices since it is based on a relationship between undeflated series.

of output. While the estimates are tentative to the point of being merely illustrative, they do lend support to the growing body of evidence that the supply of agricultural products may not be as inelastic as had often been assumed.[21] While the short-run elasticity is low, the long-run elasticity may be quite high. The estimated adjustment coefficients (around .25) do indicate that the long run may be quite far away, but they are all based on past historical experience. Given certain institutional changes, e.g. a guaranteed level of prices into the longer-run future, the adjustment coefficients may not remain the same, but increase substantially, and the long run may turn out to be closer at hand than was originally anticipated.

The time has come, I think, to drop the zero elasticity of supply view of U. S. agriculture. It is a misleading pedagogical tool, resulting in a wrong picture of agriculture and implying that farmers are somehow irrational or that the laws of economics do not apply to agriculture. Most of the policy conclusions based on a zero supply elasticity would follow as well from a 0.3 supply elasticity, but the more realistic assumption would prevent them from being carried to their logical extremes.

[21] Dale E. Hathaway reaches similar conclusions on the basis of a very different approach in his "Agriculture and the Business Cycle," *op. cit.*, and in a forthcoming paper.

THE FARM DEMAND FOR TRACTORS, MACHINERY AND TRUCKS

William A. Cromarty
Michigan State University

ONE of the neglected areas in agricultural demand analysis has been the demand by farmers for inputs produced by nonfarmers. There is certainly no unique method by which this problem may be approached and a great deal remains to be done in (1) constructing a theoretical framework suitable for the analyses, and (2) obtaining empirical results which are useful in solving related problems.

One theory is to treat the demand for the inputs as being derived from the production function. In this case the actual physical quantities of the input consumed should be measured. This immediately raises the question of a stock versus flow problem. If derived demands are used, the theory should handle problems of asset fixity and adequately explain additions to, and depletions of, stocks. This requires estimates of the expected capitalized earning power of the inputs over time and also of the expected capitalized earning power of inputs which are complementary or substitutable in the production process. Such a theoretical construction is a very ambitious and currently unsolved problem.

The approach taken in this paper is much more naive. Individual demand theory is used as a basis of construction and is transformed to all purchasers as a group. This cuts across differences caused by individual preferences, types of farming or geographical areas.

In essence, it considers the farm economy as having a demand for the services supplied by tractors, trucks and other machinery. This demand is partially satisfied by the existing stock of machinery on farms and in part must be filled by additions to the stock on farms. Budget restraints may enter through the level of farm income, and consumer choice is permitted by including machinery prices and prices or supplies of competing commodities.

In such an analysis there is considerable choice as to the type of theoretical models generated, functional form of the statistical equations, and the relevant data to be included.[1] If the price of machinery is not influenced by current sales of machinery there is good reason to use single equation, least squares models. Such is the case where manufacturers set prices at the beginning of the year and do not vary them as fluctuations in sales occur. This is probably practiced more widely for

[1] Other estimated models are presented in the two bulletins, William A. Cromarty, "The Demand for Farm Machinery and Tractors," and "The Demand For Farm Trucks," Michigan State University, Agriculture Experiment Station, in process.

trucks than for tractors and other machinery. If machinery prices do fluctuate with sales, more complex models which explain machinery prices are necessary.

In this analysis the multi-equational models have three endogenous variables, current sales, machinery prices, and the production of machinery, and are used in the tractor and "all machinery" markets. In the three-equational models retail prices are used which theoretically show prices actually paid as a result of trade-in values, price discounts given or price premiums charged.

Logarithmic functions and first difference models were experimented with but appeared to give less useful results than the models presented.

Trying to fit a theory of consumer demand to the purchase of durable inputs has many problems. Hypothesizing that purchases should vary inversely with the price of the input and directly with consumer income are fairly straightforward concepts. But even here one is left with the problem of deciding between current and lagged variables, deflated and original data, and wholesale versus retail prices. For instance, observation of machinery purchase data reveals that roughly one-half of the tractor, tillage and seeding equipment sales occur in the first four months of the year. Haying machinery is purchased heavily in May and June with corn pickers being the only major implement whose purchases are concentrated in the fall months.

By contrast in recent years the flow of income to farmers is concentrated in the last part of the year with approximately 43 per cent in the last four months and 27 per cent in the first four months.[2] For crops alone the distribution is even more concentrated in the fall months. Consequently, an income lag appears appropriate and because of the manner in which data are published a lag of one year is used in the analysis.

Data on the price of machinery at the retail level are estimates of the Agricultural Marketing Service, made four times yearly from machinery distributors. It theoretically includes allowances for trade-ins or discounts and additional price premiums charged if any. At the wholesale level, price estimates are those of the Bureau of Labor Statistics. Machinery prices are included in the analyses either as real prices, i.e. deflated by the index of wholesale prices for all commodities, or relative to the prices received by farmers for crops and livestock.

In addition to income, the current value of farm assets is included as a measure of purchasing power. Changes in the value of farm assets cause changes in the borrowing base which may be used for credit. This variable represents the real value of proprietors' equity except that liquid assets

[2] Data on income are averages for the years 1954-56 and are taken from issues of *Farm Income Situation*, AMS, USDA.

and current liabilities are given heavier weights than physical assets and noncurrent liabilities.

It is often hypothesized that machinery-labor substitution exists in agriculture. If so, the price of farm labor should affect machinery sales. However, the relationships between farm wage rates, the availability of farm labor, machinery prices and machinery purchases are very complex. They are further complicated by the introduction of new machinery into the market. Two variables are tried in the analyses. The first is an index of farm wage rates, and the second is a measure of industrial wage rates. The latter conceivably measures the pressure placed on farm producers to enter industry.

The rate at which new machinery purchases are made should vary with the volume and age distribution of the existing stock of machinery on farms. In the case of "all machinery" the stock variable is measured as the dollar value of machinery on farms at the beginning of the year deflated by an index of machinery prices. If the price index weights were accurate, this computation would measure the stock of machinery in physical units. The age distribution of machinery is important because it affects the replacement rate. It would be a gigantic task to determine a replacement rate for all machinery, but some estimates may be made for individual machinery classifications, such as tractors. One method is to estimate the length of life of tractors by observing data on purchases and stocks over time and estimating scrappage. (In one analysis on tractors a 17 year length of life was used in this manner and produced significant coefficients.) However, the length of life is not the important datum to observe but one really would like to know when obsolescence and repair costs induce new purchases. A useful life of eight years was tested for this purpose in the tractor models by constructing a weighted moving average of stocks for the previous eight years. Admittedly, this is a rough approximation to a market where new purchases may be postponed for fairly long periods of time if necessary.

One desirable hypothesis to test is the effect of average farm size on machinery purchases. Again the effects of other factors are involved. Farm sizes change slowly over time with the specialization of cropland and increasing intensity of land use being relatively more variable. In the case of crop specialization, the dollar value of machinery expenditures may increase, if not the number of physical units, as more expensive specialized machines are purchased. Increasing intensity of land use often coincides with the development and use of additional machinery. Crop specialization and intensity of use are difficult to measure and "average size of farm" is used as an associated measure to represent them.

One of the most serious problems in measuring the demand for machinery is the inability to separate the farmer and distributor, or dealer

markets. Machinery sales are measured at the manufacturer level and data on inventories at the dealer level are lacking. Thus the farmer and dealer sectors must be considered as a single unit and the effects of dealer stocks on machinery prices and farm purchases remain immeasurable. The only manner currently available to handle this problem is to assume that inventories at the dealer level follow the same pattern as those at the manufacturer level. At the manufacturer level an estimate of inventory change may be made by observing the difference between production and shipments.

Statistical Estimates for All Machinery

If machinery prices are determined independently from farm purchases, the demand for farm machinery can be estimated with a single equation. The variable explained in this case is a measure of the physical volume of manufacturers' sales of farm machinery and equipment (excluding trucks). The time period covered is for the years 1923-54 inclusive. Standard errors are given in parentheses below the regression coefficients.

$$(1.1)\quad \underset{}{Y_1} = 2397952 - \underset{(450.0)}{702.5Y_6} + \underset{(255.4)}{235.8Z_2} - \underset{(257.0)}{1206.3Z_3} + \underset{(46.3)}{28.8Z_4}$$

$$+ \underset{(4.1)}{15.6Z_5} + \underset{(22.4)}{38.6Z_6} + \underset{(2549.6)}{1232.9Z_7} - \underset{(126.5)}{433.0Z_9}$$

The coefficient of multiple determination adjusted for degrees of freedom equals $\underset{(.011)}{.95}$.

Y_1 = the value of manfacturers' sales of farm machinery and equipment for use of farms deflated by the wholesale price index for farm machinery. The deflating procedure theoretically reduces shipments in value terms to quantity terms. The value figures are based on factory prices and refer only to sales by manufacturers to dealers. The variable Y_1 is also referred to as the quantity of machinery purchased by farmers.

Y_6 = the wholesale price index for farm machinery deflated by the general price level.

Z_2 = the index of prices received by farmers for crops and livestock, deflated by the general price level.

Z_3 = the index of prices paid by farmers for items used in production excluding wages, and the components of farm machinery and motor vehicles indexes, deflated by the general price level.

Z_4 = the value of farm machinery on farms at the beginning of each year deflated by the wholesale price index for all machinery.

Z_5 = the asset position of farmers at the beginning of the year deflated by the general price level.

Z_6 = realized net income for the previous year, deflated by the general price level.

Z_7 = the average acreage of cropland per farm.

Z_9 = an index of farm labor costs, deflated by the general price level.

While elasticity estimates are hazardous concepts to discuss, they do provide some measure of the relative influence of the independent variables on machinery sales. Elasticities are computed at the mean values.

A 10 per cent increase in machinery prices has been accompanied by a 10 per cent decline in machinery purchases. A 10 per cent increase in farm prices has been associated with a 7 per cent increase in machinery purchases. A 10 per cent increase in the value of farm assets has been associated with a 6 per cent increase in machinery purchases. A 10 per cent increase in net farm income for the previous year has accompanied a 5 per cent increase in machinery purchases.

The amount of machinery on farms at the beginning of the year appears to have no effect on the quantity purchased during the year. A qualitative judgment on this variable is that while an industry is becoming mechanized such a result is not unlikely. The rapid additions to the stock of farm machinery in the past three decades have not been tempered by the stock already on farms. As a larger percentage of the farms become mechanized it would be desirable to separate annual purchases by farmers into replacement sales and additional or new sales. However, such data are not available.

The average size of farm appears to be positively related to machinery purchases. However, the changing size of farms also includes the effects of increased crop specialization and intensity of land utilization, both of which often require new types of machinery. In a predictive framework there is no way of knowing whether or not the three influences will continue to maintain the same relationship to each other as they have in the past.

The significantly negative coefficient for farm wage rates does not support the hypothesis that machinery is substituted for labor as farm wages rise. The overshadowing influence of new developments in farm machinery is one explanation of this result.

A reformulation of equation (1.1), in which the beginning stock of machinery was omitted, produced very little change in the remaining regression coefficients, but decreased the constant term considerably.

In the case where machinery prices are determined simultaneously with sales, a three-equational model is considered. For these estimates the time period of observations is changed to 1926-55 inclusive, omitting 1943 when severe restrictions were placed on farm machinery production. The limited information estimates on machinery sales are presented in (1.2).

$$(1.2)\quad Y_1 = 24970 - \underset{(10.0)}{20.76Y_6} - \underset{(10.2)}{8.60Z_1} + \underset{(.20)}{.27Z_2} + \underset{(4.4)}{8.96Z_4} + \underset{(391.7)}{512.83Z_5}$$

Y_1 = value of domestic farm machinery shipments deflated by a retail price index for farm machinery.

Y_6 = retail price index for farm machinery deflated by the wholesale price index for all commodities.

Z_1 = the ratio of prices received by farmers to prices paid by farmers.

Z_2 = the value of assets held by farmers at the beginning of the year.

Z_4 = an index of industrial wage rates.

Z_5 = a quantified measure of government price support programs.

The price elasticity of demand at the retail level is higher, being 2.5 as compared to 1.0 at the wholesale level. The elasticity with respect to farm assets is 0.4.

The parity ratio has a sign opposite to that expected. This may be an indication that farmers' decisions to purchase machinery are not largely governed by farm prices as they develop during the year. This is true where major machinery purchases are made in the spring when farm prices have only an expected value.

The variable Z_5 may be interpreted as an indicator of the effects of government programs on farmers' actions to purchase machinery. High fixed price supports on the basic crops plus no Soil Bank in operation have been associated with increased machinery purchases. Setting price supports in advance of the planting period and imposing restrictions on crop acreages tend to reduce the farmers' needs for predicting future values and cause expectations to become known with more certainty.

The two additional equations which were estimated in this model normalized the retail price of machinery and the production of farm machinery.

Statistical Estimates for Tractors

Estimating the demand for tractors rather than for all machinery has two advantages. First, it decreases the error involved in aggregating data of vastly different natures as occurs in the series for all farm machinery. Second, it permits the use of physical numbers rather than value series as a variable to be explained. In particular, wheel type tractors for domestic farm use are selected as the variable to be analyzed. The time period covered is 1926-56, omitting 1943. Fitting procedures involve least squares, and maximum likelihood limited information techniques. The equations with the definition of variables are presented below.

(2.1) Least squares estimates, $\bar{R}^2 = .78$

$$Y_1 = 2210.69 - \underset{(.846)}{1.689Y_{2/x_1}} + \underset{(.058)}{.092X_2} + \underset{(.389)}{1.434X_3} - \underset{(.195)}{.990X_9}$$

(2.2) Maximum likelihood, limited information estimates,

$$Y_1 = 3229.98 - \underset{(.960)}{2.726}Y_{2/X_1} + \underset{(.061)}{.036}X_2 + \underset{(.391)}{1.817}X_3 - \underset{(.184)}{1.130}X_9$$

Y_1 = manufacturers' shipments of wheel type tractors (excluding garden) for domestic farm use.

Y_{2/X_1} = the ratio of the index of retail prices for farm tractors to the prices received by farmers.

X_2 = net cash receipts received by farmers in the previous year.

X_3 = an eight year weighted average of the number of tractors on farms.

X_9 = average tractor sales for the previous five and six years.

Net cash receipts is equal to cash receipts from marketings plus government payments, minus current operating expenses including hired labor costs. It differs from net farm income through the omission of nonmoney income and depreciation charges.

Current tractor sales are partially determined by the number and age of tractors on farms, but researchers have not yet devised a replacement rate series which is satisfactory. The eight year weighted average of stocks is not a replacement rate series but involves some combination of replacement plus new purchases.

When the residuals from an equation involving (Y_1, Y_{2/X_1}, X_2 and X_3) were examined, an approximate five year peak to trough cycle was apparent.[3] For this reason the variable on lagged sales is included. It may be that an adequate weighting process for the stocks variable would permit the omission of X_9.

As with all farm machinery, the two additional equations in the limited information model were normalized on tractor prices and tractor production.

Statistical Estimates for Farm Trucks

One of the very real problems in estimating the farm demand for trucks is the lack of good data on farm purchases. The USDA series is in part synthetically constructed with bench marks being available in census years. The least squares estimating equation is presented below with a definition of the variables. The time period of observations covers the years 1920-1955 inclusive, omitting 1942-50.

---

[3] In other analyses predictions were made for a five year period based upon fitting a modified exponential curve to tractor stocks and projecting it to 1962. Estimates of annual tractor sales were then made based upon the approximate ten year cycle that appears in the ratio of stocks to sales. The results compare quite satisfactorily with independent estimates of some of the farm machinery manufacturers.

$$Y_1 = 31.559 + .005X_1 - .037X_2 + .180X_3 + 1.940X_4$$
$$\qquad\qquad (.001) \quad (.016) \quad (.074) \quad (.905)$$

The adjusted coefficient of multiple determination equals .98.

Y_1 = annual purchases of new trucks by farmers.
X_1 = net farm cash receipts for the current year.
X_2 = the ratio of truck prices to prices received by farmers.
X_3 = the replacement rate for trucks.
X_4 = the value of trucks traded in by farmers.

The income elasticity of demand for trucks is estimated at 0.44, while the elasticity of demand using the ratio of truck prices to prices received by farmers approximates 0.31, measured at the mean values.

The replacement rate for trucks is a series developed by the USDA by estimating the proportion of trucks scrapped each year from the beginning inventory. Currently the series is estimated at 11 per cent.

The value of trucks traded in gives some indication of the strength of the used truck market, although the estimated value of trade-ins generally equals only from 5 to 10 per cent of the value for total truck expenditures.

Machinery Demand Variations and the Business Cycle[4]

As mentioned previously, elasticity concepts are hazardous to use. One reason is that demand curves shift as farmers postpone purchases during depressions and speed up purchases during prosperous periods. Research by Fettig gives some indication of the varying demand for machinery as related to upswings and downswings in the business cycle. The results of his research are stated in brief.

Net cash farm income for the previous year is more closely associated with machinery purchases during contractions than during expansions. This suggests that farmers reduce expenditures as a result of farm income decreases more rapidly than they increase expenditures as a result of farm income increases.

Capital gains and losses were associated with machinery purchases during *expansions* but during contractions the regression coefficients were quite consistently opposite in sign to that expected and not significantly different from zero.

For the price of machinery relative to farm prices no differences were revealed between expansions and contractions.

The time variable, insofar as it reflects the development of technology for use in agriculture, indicates that farm tractor and machinery purchases

[4] Material for this section is taken largely from Lyle P. Fettig, *Purchases of New Farm Tractors and Machinery in Relation to the Non-farm Business Cycle*, unpublished M. S. thesis, Michigan State University, 1958.

during expansions have been more closely related to the presence of new technology than during contractions. New technology appears to have been adopted at a faster rate during expansions than during contractions. The stock of machinery on farms and the relative price of hired farm labor had signs opposite to those expected.

Usefulness of the Models in Predicting

The models for all farm machinery were used in predicting manufacturers' sales for the years 1955-58. For 1955 the prediction was within 2 per cent of the actual published figure. For 1956 and 1957 the models overestimated actual sales by 12 and 23 per cent respectively. The 1958 prediction was almost identical with that for 1957 and again will be an overestimation.

For the tractor models predictions were made for 1957 and 1958. For 1957 the least squares estimate was for 234,000 units and the limited information estimate was for 199,000 units. The actual figure probably approximated 210,000 units. For 1958 the estimates were in the range of 280,000 to 290,000.[5] This will overestimate sales by a substantial amount. One of the reasons for overestimation in the tractor models is the trend toward purchasing tractors of larger horsepower in recent years. In 1951 approximately one-half of the tractors produced were in the 10-29 horsepower class and about 13 per cent had 40 or more horsepower. In 1957 over 50 per cent had 40 or more horsepower and about 14 per cent were in the 10-29 horsepower class. The models did not include such a rapid structural change.

In the case of farm trucks predictions were made for the years 1956-59. In 1956 and 1957 the predicted values were for 160,000 and 158,000 respectively. These estimates were made using actual values for the independent variables. This compares with actual values of 163,000 and 164,000. For 1958 and 1959 predicted values were for 162,000 and 151,000 new trucks to be sold to farmers. Estimated values for the independent variables were used for these two years.

These models were developed in the hope of providing more information on the effects which changes in agriculture have on inputs purchased from the nonfarm sector. No attempt is made to suggest what, if any, policy implications may be deduced from the empirical findings. Furthermore, these analyses are only a beginning in this area. Regional differences, the extension to other inputs, different statistical and theoretical models, and data improvement are but a few of the many additional research areas which could be expanded.

---

[5] 1958 estimates were made in July of 1957 and were not corrected for errors in the independent variables.

NATIONAL AND REGIONAL DEMAND FUNCTIONS FOR FERTILIZER*

EARL O. HEADY AND MARTIN H. YEH
Iowa State College

THIS study deals with the demand for a particular resource, fertilizer, by farmers. It is part of a larger study dealing with resource demand and product supply by farmers. It is an aggregative study, based on time series data, indicating the variables related to United States fertilizer use.

Improved knowledge of variables important in resource demand by farmers is necessary for understanding supply phenomena. Agricultural economists agree that major problems of agriculture revolve around the quantities of farm output and resources used. To date, several studies of aggregate output phenomena have suggested that the elasticity of the aggregate short-run supply function for farm products is low in the short run. However, research in indicating the quantitative effect of product and factor prices and other related variables on output has not been extremely successful. A proposition which serves as the foundation for this study is: Supply phenomena might better be understood if variables relating to demand for agricultural resources are quantified. Farmers make their more exact decisions on inputs; they only anticipate output, since exogenous variables such as weather and nature cannot be predicted or controlled.

Fertilizer was selected for the current study since time series data are available, both for the various regions of the United States and for individual nutrients. Also, fertilizer is a resource which is easily divisible. In contrast to resources such as tractors and machinery, an individual farmer can purchase fertilizer in pound or ton quantities. He can readily adjust its use as prices of fertilizer or crops, or other relevant variables change in magnitude.

The main objectives of this study are to estimate demand functions for commercial fertilizer and individual nutrients for the United States and regions, and to express demand elasticity for fetilizer relative to fertilizer price, crop prices, and other relevant variables. Also, prediction has been made of demand functions for individual producing regions of the United States. The statistics presented are from single equation, least squares models. These appear largely sufficient for the types of phenomena involved. We have applied some simultaneous equations and "expectation" models, for methodological purposes, but will not present them or the

* Journal Paper No. J-3552, Iowa Agricultural and Home Economics Experiment Station, Iowa Agricultural Adjustment Center Cooperating, Ames, Iowa. Project No. 1135. This project has been partially financed by a grant from TVA.

results of certain other functions, because of time and space limitations. We merely summarize some of our work here.

Functions Fitted

Numerous algebraic forms of functions were employed; the main ones being a Cobb-Douglas type, one of first differences in logarithms, a linear and a modified quadratic form. Dependent variables included in the several demand functions are Y_1 = total tons of commercial fertilizer consumed; Y_2 = total tons of nitrogen consumed; Y_3 = total tons of phosphoric acid consumed; Y_4 = total tons of potash consumed, all in the current year. Independent variables are: X_1 = fertilizer price index, at planting time, deflated by the general wholesale price index for the current year, with 1910-14 used as the base period; X_2 = average crop price index, lagged one year, deflated by the general wholesale price index; X_3 = cash receipts from farming (including crops, livestock and its products, and government payments), lagged one year; X_4 = cash receipts from crops and government payments, lagged one year; X_5 = total acreage of cropland; X_6 = time; X_6^2 = time squared; X_7 = an income fraction, indicating trends in income over the previous three years. This variable ($X_7 = \Delta I$) is measured as follows (where I_{t-i} is defined as income in the $(t-i)^{th}$ year):

$$\Delta I = \frac{I_{t-1}}{I_{t-2}} + \left(1 - \frac{I_{t-3}}{I_{t-2}}\right) + \left(1 - \frac{I_{t-4}}{I_{t-3}}\right)^3$$

Fertilizer price at approximate planting time and crop price for the previous year are used because these quantities are most readily available for decision making. The farmer knows the fertilizer price at this time, but he can only work on the basis of expectation for crops to be harvested. But the model supposes, perhaps incorrectly, that the crop price of last year serves as an expectation for the year ahead.

National Demand for All Commercial Fertilizer

The results for a five-variable demand function for the time period 1926-56 and a six-variable demand function for the time period 1910-56 are indicated in equations (1) anwd (2), respectively, for the United States. Both equations omit the period 1944-50, because fertilizer production capacity was short during the period and rationing of fertilizer generally existed. (This was less important in the early war period when fewer farmers used fertilizer.) On an *a priori* basis, these years were left out of the period, before calculations were begun for the national analysis. However, for most purposes, the empirical results would probably have "been

improved" had they been included. The lower case letters indicate that observations are in logarithms. A variable for crop prices was dropped from the first equation because it was nonsignificant. This was probably due to the presence of the income variable. Standard errors of the regression coefficients are given in parentheses below the coefficients.[1]

$$(1)\quad \hat{y}_1 = 10.677 - \underset{(0.201)}{0.490^{*}}x_1 + \underset{(0.054)}{0.637^{**}}x_3 - \underset{(0.615)}{1.082^{\dagger}}x_5 + \underset{(0.022)}{0.076^{**}}x_6$$

$$(2)\quad \hat{y}_1 = 28.338 - \underset{(0.366)}{1.712^{**}}x_1 + \underset{(0.390)}{0.475^{\#}}x_2 + \underset{(0.108)}{0.089}x_4 - \underset{(1.419)}{2.357^{\dagger}}x_5 + \underset{(0.086)}{0.174^{*}}x_6$$

The coefficient of determination (R^2) is .988 for the first equation and .865 for the second equation. (The standard errors of estimate are respectively .028 and .081.) The mean elasticity coefficient for fertilizer price (X_1) was -0.49 in equation (1) and -1.71 in equation (2). These coefficients would indicate that, on the average, if fertilizer price decreases by 1 per cent, *ceteris paribus,* the quantity of fertilizer used by farmers is predicted to increase by about one-half of 1 per cent and 1.71 per cent, using equations (1) and (2), respectively. The mean elasticity coefficient for cash receipts from farming (X_3) was 0.64 in equation (1). Using this coefficient, one would come up with the following meaning: if cash receipts change by 1 per cent, use of fertilizer is predicted to change in the same direction by about two-thirds of 1 per cent. However, the mean coefficient for cash receipts from crops plus government payments (X_4) was not significant in equation (2), though it is apparently affected by crop prices in the previous year (X_2). The cash receipts variable and the crop price variables might well be considered as substitutes, since they are highly correlated and hence are included separately in the two equations. The elasticity coefficient for fertilizer use with respect to crop prices, estimated only in the second equation, was 0.47 indicating that if crop prices change by 1 per cent, use of fertilizer is predicted to change in the same direction by about one-half of 1 per cent. In terms of profit maximization, it is, of course, the fertilizer/crop price ratio which is important. However, elasticity or regression coefficients were estimated separately, to better suggest directly the relative effect of fertilizer and crop changes on fertilizer use. Some agriculturists and manufacturers speculate that a decline in crop prices is more effective than an increase in fertilizer prices, in causing reductions in fertilizer use such as took place in 1955-57. However, using equation (1), there would be no basis for this conclusion, and the price ratio would still be the important decision-making variable. What is probably remembered, by those advancing the above hypotheses, is that fertilizer use continued to increase in postwar years as fertilizer prices increased, but

[1] Levels of significance indicated in equations are: ** = 1 per cent, * = 5 per cent, † = 10 per cent, and # = 20 per cent.

declined somewhat abruptly with the break in crop prices in 1955. However, it should also be remembered that crop prices were rising at a more rapid rate than fertilizer prices in early postwar years, causing the fertilizer/crop price ratio to favor increased fertilizer use. This ratio declined with the 1955 break in crop prices, causing fertilizer use to be less profitable. In a secular sense, the price of fertilizer has risen less rapidly than the price of crops, favoring an extended use of fertilizer over the long pull. Certainly, the decline in the fertilizer/crop ratio has been an important, but not the only, variable causing a rapid increase in fertilizer use in postwar years. Several factors have contributed to a more favorable ratio and probably include improved manufacturing technology for a given material, the advent of new fertilizers and materials and greater competition in the manufacture and distribution of fertilizer. The number of manufacturers and distributors has increased greatly over the last two decades.

The sign of the mean elasticity coefficient for the cropland acreage (X_5) was negative in both equations (1) and (2), indicating that a decrease in the acreage of cropland is predicted to cause an increase in use of commercial fertilizer. For the United States as a whole, there appears to be an important substitution effect between the cropland acreage and fertilizer use. This is obviously true in a technical sense. Fertilizer experiments over the nation show imporant yield responses from fertilizer application. Using these data for inference, one notices that land and fertilizer substitute at a diminishing rate, because marginal products of fertilizer decline as more is applied on a given land area. The forces causing fertilizer to be substituted for cropland more especially, however, have been those of sporadic control programs where farmers have been paid to take land out of crops, and, many people hypothesize, make it up by applying more fertilizer and other new technological inputs. Data are presented later for specific regions, suggesting that the apparent "direct" substitution of fertilizer for land may simply be a confounding of other variables.

The mean elasticity coefficient for time (X_6) was significant at the 1 per cent level in equation (1) and at the 5 per cent level in equation (2). These statistics would suggest that there has been a significant upward shift in the demand function as associated with time. We know, of course, that one of the sins in regression analyses based on time series data is to include a time variable as a "catchall." But while we might be slightly guilty in this respect, we actually included it for reasons which we believe are important. We included it to represent the greater technological knowledge (i.e., an increase in the marginal product ratio) which has come to farmers over time, particularly in the last two decades. This new knowledge has come from fertilizer experiments, farmers' own "findings" in fertilizer use and from intensive educational and sales programs by the

Extension Services, T.V.A. and commercial firms. Quite obviously, this "time-knowledge" variable has been important. In many parts of the Midwest, agronomists did not recommend fertilizer use prior to 1940 (and farmers in general follow after specialists in their knowledge). Other techniques also were important in causing the marginal productivity of fertilizer to rise. (The magnitude of the marginal product, and rough knowledge of it, are equally important with the price ratio, in determining profitable fertilizer quantities.) In pre-hybrid days, over most of the Corn Belt, the region which has moved into first place in total quantity of nutrients purchased by farmers, soil fertility generally was not the limiting factor in yields; but in post-hybrid days, it became so. Research on seeding rates and rotations has led to higher possibilities in fertilization rates even in the past 10 years. Farmers' decisions have been affected by these findings. In the Great Plains, the region with the greatest percentage increase in fertilizer use over the past two decades, fertilizer was seldom recommended for the main crop, wheat, in earlier periods because (a) the original soil supplies of phosphates and potash were high and nitrogen was "fixed" by soil bacteria as rapidly as it was needed and (b) moisture, not other chemicals, was the limiting factor in production. Fertilizer was not recommended or used because it gave little or no response over most of the region. But with the advent of summer fallow, new rust and pest resistant wheat varieties and other techniques such as planting date and irrigation, and with the gradual "using up" of the original nutrient supply, fertility has become a limiting factor in much of the area. Fertilizer research eventually has shown some response; information which has been passed on to, and used by, farmers. Certainly, technical change and knowledge, provided gradually over time to farmers, have been important along with price ratios in causing an increase in demand for fertilizer. While our time variable is an imperfect measure of the complex of technical change and knowledge or other variables, we believe that it is important in reflecting the phenomena explained above. While the elasticity coefficient is small in equation (1), the one we prefer for inference because of the higher R^2 and other reasons, its accumulative effect over years is quantitatively important. The improved capital position of farmers undoubtedly has been important also, but is not measured in this study.

Figures 1 and 2 show the actual and predicted fertilizer consumption from equations (1) and (2) respectively. The comparisons for the two equations suggest that there has been a shift in the demand between the prewar and postwar periods. Excluding the period in which the output of fertilizer generally fell short of the demand and formal or informal rationing existed, there were insufficient observations for estimating a separate postwar function. For equation (1) and (2), the level of demand, predicted from the variables included and the coefficients derived, generally underestimated the amount of fertilizer used after 1950, when

differences in predicted and actual consumption are much greater than in prewar years. Equation (1) with an extremely high coefficient of determination, .988, is in error in direction of change in only four out of the 24 years. However, if the regression coefficients are derived only for the years 1926-40, and estimates are made for these for postwar years, predictions are nearly as good.

In a purely positivistic sense, other simple models predict about equally well. Equations which include two such variables as fertilizer consump-

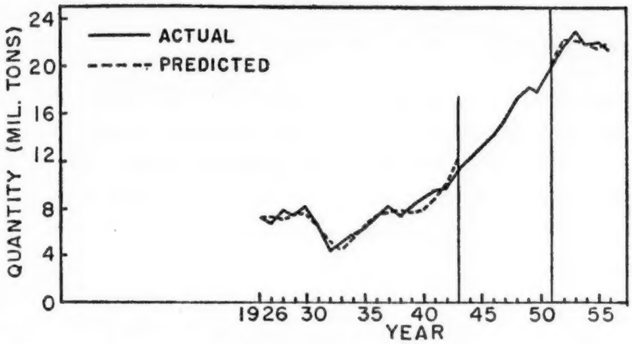

FIG. 1. ACTUAL FFRTILIZER COMPARED WITH THAT PREDICTED FROM EQUATION 1 FOR THE U.S., 1926-56.

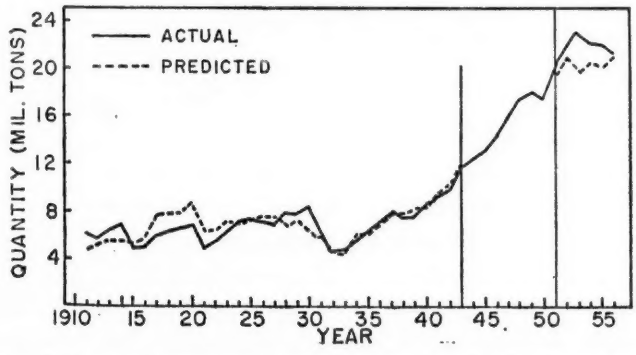

FIG. 2. ACTUAL FERTILIZER USE COMPARED WITH THAT PREDICTED FROM EQUATION 2 FOR THE U.S., 1910-56

tion and income change or fertilizer/crop price ratio, both of the previous year, serve about as well if we are only interested in quantity of fertilizer use in a particular year. Even time and the price ratio or change in income of the previous year, with regression coefficients in linear form, serve quite well if applied to all postdepression years. This model might assume that major variables are technical knowledge, reflected by the time variable, and the price ratio.

Several other models were applied to the data, in an attempt to more

nearly determine the quantitative effect of specific individual variables. However, most of these appeared no more efficient than equation (1). Logically, it would appear that the relevant variables are all of predetermined or exogenous nature. But a small simultaneous model, restricted because of available data on the supply side, was applied. Again, it appeared less efficient than equation (1). An expectation model, similar to one proposed by Nerlove,[2] gave similar results. Another regression model perhaps worthy of presentation is the first difference equation in (3), with lower case letters referring to observations in logs.

$$(3)\quad \hat{y}_t - \hat{y}_{t-1} = -.009 - .770^{**}(x_1 - x_{1(t-1)}) + .246^{\#}(x_2 - x_{2(t-1)}) + .138^{\dagger}(x_{4(t-1)} - x_{4(t-2)}) - .862^{*}(x_5 - x_{5(t-1)}) + .491^{**}(x_6 - x_{6(t-1)})$$

This equation can be transformed to predict total fertilizer consumption and, accordingly, represents a semi-expectation model. While, as indicated in Figure 3, absolute errors in postwar years, for predictions of total fertilizer consumption, were less by this model than by equation

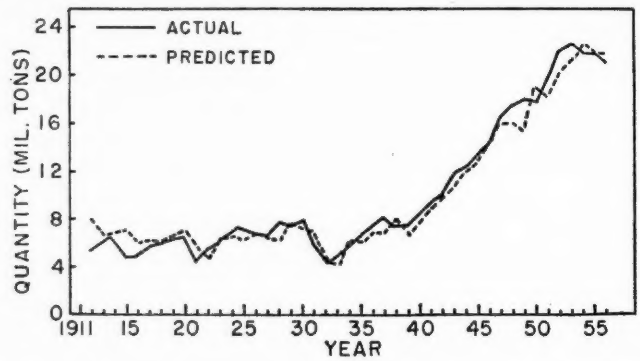

FIG. 3. ACTUAL FERTILIZER USE COMPARED WITH THAT PREDICTED FROM FIRST DIFFERENCE EQUATION FOR THE U.S., 1910-56.

(1), the coefficient of determination is only .670 (referring variance in year-to-year change). Also, the direction of demand change, as predicted by the first difference equation, is in error more often than for equation (1). In a way, simple models can be derived for these time series data, to accomplish about whatever the investigator wishes, although it is difficult to unfold a single model which accomplishes all of these ends.

National Demand Functions for Individual Nutrients

A single United States demand function might serve equally well in predicting demand for individual nutrients if: all nutrients were limita-

[2] M. Nerlove, "Estimates of the Elasticities of Supply of Selected Agricultural Commodities," *Journal of Farm Economics*, Volume 38, 1956, pp. 496-509. Significance levels: ** = 1 per cent, * = 5 per cent, † = 10 per cent, and # = 20 per cent.

tional factors or all were used on the same crops and had the same production function. However, these conditions are hardly true and considerable difference has occurred in trends of use for the individual nutrients over the past several decades. Since 1926, use of nitrogen has increased by about 600 per cent, even though it generally has had a higher unit price than other nutrients. Use of P_2O_5 has increased by about 200 per cent while use of K_2O has increased by about 500 per cent. Because of these differences, separate U. S. demand functions were estimated for the three nutrients.

The regression equations for individual nutrients are of the same form as equation (1), used to predict demand for fertilizer in aggregate. The results are summarized in Table 1. Over 95 per cent of the variance in

TABLE 1. REGRESSION COEFFICIENTS (b_i) AND RELATED STATISTICS FOR INDIVIDUAL NUTRIENT DEMAND FUNCTIONS, UNITED STATES, 1926–56 WITH 1944–1950 OMITTED

	Nitrogen		Phosphoric Acid		Potash	
	b_i	s_{b_i}	b_i	s_{b_i}	b_i	s_{b_i}
log X_1	− .449	.512	− .448**	.095	− .403	.395
log X_3	.804**	.138	.579	.353	.881**	.106
log X_5	−1.691	1.564	−2.368*	1.078	−1.294	1.206
log X_6	.207**	.055	.079†	.038	.217**	.042
R^2	.957	—	.959	—	.977	—
S	.071	—	.049	—	.054	—
log a	12.699	—	21.145	—	8.436	—

Significance levels: ** = 1 per cent, * = 5 per cent, and † = 7 per cent.

fertilizer use is "explained by" the variables in the three equations. The coefficients all have the same sign, as in equation (1) for fertilizer in aggregate. The regression coefficient for fertilizer price is of a remarkably similar magnitude for all three nutrients. In terms of magnitude of regression coefficients alone, it is predicted that the elasticity of fertilizer demand in respect to fertilizer price is about equal for all three nutrients. Similarly, income (and likely crop price) change appears to have about the same relative effect on fertilizer demand by farmers. Greater differences appear to hold true for mean elasticities in respect to cropland and time. To the extent that reduction in cropland due to sporadic control programs themselves leads to heavier fertilization, the higher elasticity might be expected for phosphate. Typically, controlled land has been planted to hay, crops using relatively more phosphate than nitrogen or potash. (A better indication of the "real economic substitution" of fertilizer for land would be, of course, an empirical indication of the shift relative to the prices of the two factors; but available data do not allow this measure.)

The main other difference is in respect to the elasticity coefficient for time. Perhaps the difference again, to the extent it is meaningful, is a reflection of technical change and knowledge. Phosphates have been used especially for hay in earlier years and while increased knowledge of their response with grains, along with favorable price ratios, led to greater use for this purpose, it would be less so than for nitrogen which has become technically more important for grains. The relatively larger coefficients for nitrogen and potash at least would suggest that demand for these nutrients has increased more with time, than in the case of phosphate. This change in use of nutrients also is expressed in the change in the "aggregate mix" of fertilizer over time. In 1926, the aggregate mix, in N-P-K order, was in the ratio .41-1.00-.41. In 1956, it was .85-1.00-.83; again supporting the proposition of great similarity in time elasticities for nitrogen and potash in Table 1.

Summation of the three nutrient demand equations represented in Table 1 also provide a total nutrient demand function for the United States. However, improvement is so slight, compared to estimating the total function directly, and as might be expected, nothing of importance is gained in doing so. Yet, examination of the individual nutrient demand functions suggests that errors in "underpredicting" postwar demand for all nutrients stems especially from the nitrogen and phosphate components. In most postwar years when the fertilizer/crop price ratio increased, use of nitrogen and potash continued to increase, suggesting that increased technical knowledge, or other phenomena related to time, offset the price effect. In contrast, phosphate consumption has declined more rapidly and in greater magnitude, in response to an increase in the fertilizer/crop price ratio. Again, this is consistent with our hypothesis that improved technical knowledge in recent decades has been more important for nitrogen and phosphate.

Regional Demand Functions for All Commercial Fertilizer

Theoretically, the two important variables affecting fertilizer use in an environment of profit maximizing goals and where capital limitations, tenure conditions and similar variables do not affect decisions on investments, would be the magnitudes of marginal product and price ratios. While this is not the true environment of farm decision-making, production functions do differ greatly between regions, because of soil types, climatic conditions, crops grown and the natural stocks of nutrients in the soils. Because of these differences especially, and because research on and knowledge of fertilizer response has not moved ahead at equal rates in the various regions, demand functions for all commercial fertilizer have been estimated for 10 geographic regions of the United States. Some of those derived to this point in time will be presented. All are single equation regression models.

But before these are presented, we will summarize some differential regional trends. In prewar periods, very little fertilizer was used in some regions, regardless of the fact that the factor/product price ratio was relatively as favorable at the time as in regions using more fertilizer. But with development of more knowledge of the fertilizer production function, and even from a change in the production function as soil supplies of nutrients were exhausted and other complementary techniques were developed, there have been some large percentage increases in fertilizer demand. Thirty years ago, the largest users of fertilizer were the northeast and southern states. In 1910, the Appalachian, northeast, southeast and Delta regions used 93 per cent of all chemical fertilizer. In 1940, they still used 90 per cent, but only 60 per cent in 1956, although their usage had increased 140 per cent. In contrast, use of fertilizer increased 44-fold in the northern plains and by 14- and 10-fold, respectively, in the Mountain and Pacific regions between 1940 and 1956. It increased by over 600 per cent in the Corn Belt, Lake states and Southern Plains regions, and the Corn Belt is now the largest user. These differences exist even though the real cost of fertilizer relative to crop prices has declined similarly for all regions. Hence, variables other than fertilizer/crop price ratios and historic quantities of fertilizer used would seem important. For this reason, again, time has been included as a variable to reflect, even imperfectly, changes in knowledge of techniques and in production functions. Where appearing applicable, an income variable also has been included. In some regions (for example, drouth in the plains and low hog prices in the Corn Belt), marked decline in income and capital rationing might well offset fertilizer/crop price ratios in influencing level of fertilizer use. Generally, however, equations which have a significant income variable do not also have a significant crop price variable since the latter is reflected in the former. Some of the regional functions derived are now summarized.

Functions Fitted

Different time periods also have been used, depending on the region. Variables are the same as those outlined previously. The variable to represent income from farming was selected according to the importance of cash receipts from crops and livestock. Livestock income is included for regions 1, 2, 3, 7, and 8.

Results for 5- and 6-variable power functions are summarized in Table 2. The R^2 value is upward of .90 for all regions. The elasticity of demand in respect to fertilizer price was greatest in the regions which have increased use mostly in recent years; namely, the Corn Belt, Lake states, Great Plains, Mountain and Pacific regions. These mean elasticity coefficients ranged from .425 in the Northeast to 3.839 in the Northern Plains. One might hypothesize that fertilizer price elasticities would naturally be

lower in the South, or "old using" area, because farmers have been highly short on capital and nowhere near have used fertilizer to a point where its marginal product is driven near the level of the price ratio. Hence, they could more nearly still use fertilizer profitably, even with some increase in its relative price, but lack capital to use much more under the opposite change. Perhaps also fertilization of hay crops for dairy feed more nearly dominates the picture in the Northeast, with responsiveness to the relative prices for fertilizer being greatest in the midwest and western areas of grain and cash-crop production.

The elasticity, .52, in respect to crop prices was greatest in the Southeast region, although only four equations retained this variable after preliminary analysis. The demand for fertilizer was significantly responsive to the price of cotton, tobacco, fruit and truck crops, but not to the price of small grains and hay in mixed farming areas. The mean coefficients (elasticities) for either cash receipts of farming (X_3) or cash receipts from crops plus government payments (X_4) in both the 5- and 6-variable equations, and which also reflect level of crop prices, were significant at the 1 per cent level in all regions. The elasticity of 1.27 was highest in the Southern Plains, followed closely by a coefficient of 1.22 in the Northern Plains. Both regions have incomes affected as much or more by weather as by crop and fertilizer prices. The income elasticity also was high in the Corn Belt and Lake states, but was lowest in the Northeast where livestock income predominates more over crop income.

The elasticity sign for fertilizer with respect to cropland acreage was negative in regions 1, 2, 3 and 8, and positive in the remaining regions. As mentioned previously, the negative coefficients might be taken as an indication of substitution of fertilizer for land, a situation which is not directly reflected for the other six areas. The coefficients are not significant in most of the regions where they are positive. Perhaps the negative coefficients for cropland represent a "confounded effect"; for example, a shift of land from farm to urban uses in the Northeast, at a time when the fertilizer/crop price ratio has had a downward trend. Similarly, expansion of irrigated land in the western states, with greater use of fertilizer on this acreage has taken place at a time when total cropland acreage has declined due to control programs.

The computed elasticity of fertilizer use with respect to time was the highest (1.07) in region 9, followed by .43 in region 8, .38 in region 10, and the lowest, .002 in region 5. Not only was the coefficient highest in the regions which tend to have increased use most in recent years, but also the coefficient was mainly significant in these areas. Again, we believe that these somewhat sketchy findings suggest the demand function, particularly as it relates quantity to fertilizer/crop price ratios, has shifted rightward, especially in those areas where technical knowledge on ferti-

TABLE 2. REGRESSION COEFFICIENTS (b_i) AND RELATED STATISTICS IN 5- AND 6-VARIABLE POWER FUNCTIONS FOR COMMERCIAL FERTILIZER DEMAND IN THE 10 REGIONS, 1926–1956 (OMITTING 1944–1950)

	Region	log a	log X_1		log X_2		log X_3 or log X_4[c]		log X_5		log X_6		R^2
			b_1	s_{b_1}	b_2	s_{b_2}	b_3 or b_4	s_{b_3} or s_{b_4}	b_5	s_{b_5}	b_6	s_{b_6}	
1	Northeast[a]	5.145	−0.425**	.123	—[b]	—[b]	0.342**	.043	−0.180	0.218	0.040†	.022	.970
2	Corn Belt	6.935	−1.392**	.402	—[b]	—[b]	1.075**	.150	−1.073	0.960	0.037	.049	.981
3	Lake States	7.095	−0.984*	.367	.001	.155	1.069**	.109	−1.285	1.249	0.248**	.047	.983
4	Appalachian	−4.205	−0.563†	.303	—[b]	—[b]	0.463**	.094	1.015*	0.450	0.072*	.039	.942
5	Southeast[a]	3.746	−0.712**	.176	.519**	.090	0.237**	.057	0.133	0.155	0.002	.025	.954
6	Delta	−6.503	−0.893	.752	.176	.382	0.875**	.240	0.827††	0.517	0.070	.089	.896
7	Southern Pl.	−9.301	−1.245#	.939	.360#	.269	1.265**	.200	0.080	1.249	0.080	.102	.958
8	Northern Pl.	2.033	−3.839**	.761	—[b]	—[b]	1.222**	.238	−0.232	0.577	0.427**	.091	.980
9	Mountains	−2.891	−1.266#	.917	—[b]	—[b]	0.718**	.241	0.354	0.763	1.074	.104	.971
10	Pacific	−3.530	−1.057*	.481	—[b]	—[b]	0.757**	.133	0.563	0.700	0.378**	.056	.982

[a] Regions 1 and 5 covered the whole period 1926 to 1956.
[b] Variable not included in equation.
[c] X_3 included in equations for regions 1, 2, 3, 7, and 8 and X_4 included in equations for regions 4 5, 6, 9, and 10. Levels of significance: **=1 per cent, *=5 per cent, †=10 per cent, ††=15 per cent and #=20 per cent.

TABLE 3. REGRESSION COEFFICIENTS (b_i) AND RELATED STATISTICS FOR 5- AND 6-VARIABLE FIRST DIFFERENCE EQUATIONS FOR COMMERCIAL FERTILIZER IN THE SIX REGIONS, 1926–1956, OMITTING 1944–1950. (LOWER CASE x_i VALUES INDICATE OBSERVATIONS IN LOGS.)

	Region	a	$x_1 - x_{1(t-1)}$		$x_{2(t-1)} - x_{2(t-2)}$		$x_{3(t-1)} - x_{3(t-2)}$ or $x_{4(t-1)} - x_{4(t-2)}$[c]		$x_5 - x_{5(t-1)}$		$x_6 - x_{6(t-1)}$		R^2[d]
			b_1	s_{b_1}	b_2	s_{b_2}	b_3 or s_{b_4}	s_{b_3} or s_{b_4}	b_5	s_{b_5}	b_6	s_{b_6}	
1	Northeast[a]	.000	−0.363†	0.193	.048	.104	.283**	.080	.002	.322	.078	.078	.390
2	Corn Belt	.002	−1.141†	0.610	—[b]	—[b]	.706**	.186	−.680	.738	.063	.201	.511
3	Lake States	.015	−0.556	0.572	.213*	.098	.633**	.164	.464	.836	.119	.182	.606
5	Southeast	.000	−0.355	0.521	.655**	.172	.117	.095	−.324	.411	.655	.173	.549
6	Delta	.003	−0.691	1.103	.582*	.288	.597*	.267	−.254	.640	.142	.370	.530
10	Pacific	.023	−0.842*	0.385	—[b]	—[b]	.326**	.105	−.370†	.238	.130	.119	.475

[a] Region 1 covered the whole period 1926–1956; [b] Variable not included in this equation; [c] x_3 included in equations for regions 1, 2 and 3 and x_4 included in equations for regions 5, 6 and 10; [d] All R^2 refer to variance in year-to-year change. Significance levels: **=1 per cent, *=5 per cent, and †=10 per cent.

lizer response is more recent; or even where the response function has changed due to depletion of soil nutrient stocks and creation of new varieties and practices. Heavy rainfall and leaching long ago reduced original soil nutrient supplies in the Southeast, and fertilizer response there was quite well known 40 years back. While technical knowledge there also has increased, this change probably has been relatively less important than price ratio changes for fertilizer, especially compared to the "newer using" regions.

The demand functions for the individual regions can be summed, to provide a national demand function comparable to equation (1). When this is done, errors of estimate are slightly somewhat less for the postwar period, and somewhat greater for prewar years. This occurs, of course, because of the "weighting" given the "newer using regions" under the two methods.

Regional demand functions for total nutrients, in contrast to all commercial fertilizer in Table 2, also were computed. However, these results are similar to those outlined above and are not presented here. The data for total nutrients suggest a somewhat higher elasticity coefficient for fertilizer price and a uniformly higher coefficient for time, than do the functions for all commercial fertilizer. The latter finding is entirely consistent with the trend over time, in manufacture and education as well as in price, to emphasize the analysis level of fertilizers, rather than just the tonnage.

Choice of Alternative Equations for Commercial Fertilizer, 1926-56

Since variation on fertilizer practices occurs among the 10 regions in the United States, additional demand functions were derived using first difference, linear and modified quadratic equations. The variables in each of the alternative equations are the same as those used in Table 2. Here we "peek at our data," to examine various functions; previous functions were fitted purely on an *a priori* basis.

Results of first difference equations for regions 1, 2, 3, 5, 6, and 10 are given in Table 3 for all commercial fertilizer over the period 1926-56. Figure 4 compares commercial fertilizer consumption with that predicted from first difference equations. The predicted quantity-time curves from these equations correspond more closely to the actual use curve than those for the same regions from the equations in Table 2. (Graphs for equations in Table 2 are not included in this paper.)

Regression coefficients from first difference equations in Table 3 were significant at about the same level as those in Table 2. The portion of variance in change in fertilizer use explained by these equations is less than the portion of variance in total fertilizer use explained by the equations in Table 2. However, as Figure 4 indicates, correspondence between

actual and predicted total use is reasonably close, especially in regions 1 and 10. Other models might appear more appropriate for others of these regions.

Linear equations were fitted to the time series data for regions 1, 3, 4, 5, 6 and 7. The relevant statistics are given in Table 4. As compared to

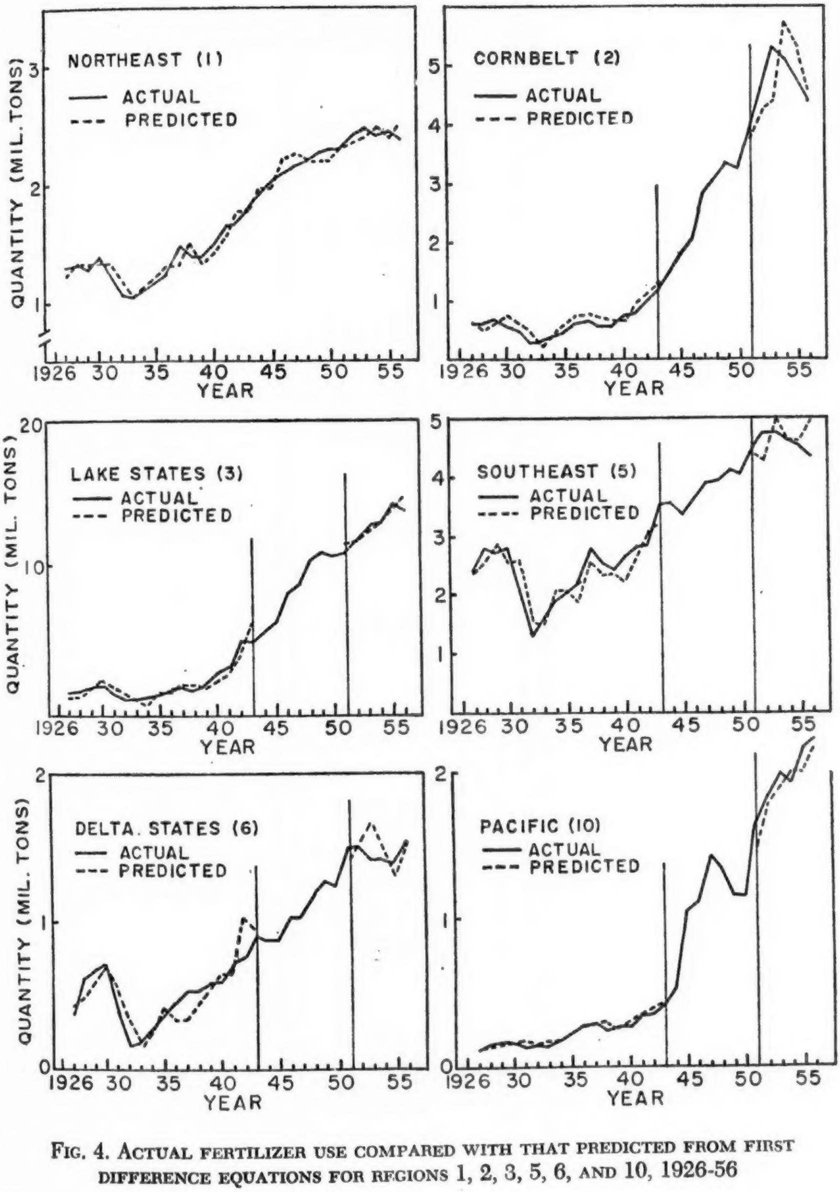

FIG. 4. ACTUAL FERTILIZER USE COMPARED WITH THAT PREDICTED FROM FIRST DIFFERENCE EQUATIONS FOR REGIONS 1, 2, 3, 5, 6, AND 10, 1926-56

TABLE 4. REGRESSION COEFFICIENTS (b_i) AND RELATED STATISTICS FOR 5- AND 6-VARIABLE LINEAR EQUATIONS FOR COMMERCIAL FERTILIZER IN THE (SIX) REGIONS, 1926–1956, OMITTING 1944–1950. (UNITS OF COEFFICIENTS FOR a, X_1, X_2, AND X_6=10,000 TONS.)

Region		a	X_1		X_2		X_3 or X_4[c]		X_5		X_6		R^2
			b_1	s_{b_1}	b_2	s_{b_2}	b_3 or b_4	s_{b_3} or s_{b_4}	b_5	s_{b_5}	b_6	s_{b_6}	
1	Northeast[a]	93.476	− .600	.311	.115	.147	.00026**	.00004	.018	.025	2.111*	.760	.975
3	Lake States	113.502	− .009	.271	.027	.115	.00038**	.00003	−.041*	.020	1.856**	.442	.982
4	Appalachian	221.736	−1.422	.763	.463	.470	.0013**	.0003	−.013	.055	1.339	1.375	.965
5	Southeast[a]	211.826	−1.551	.899	.149	.336	.0019**	.0004	.027	.030	1.012	1.355	.941
6	Delta	−5.111	− .328	.416	.190	.225	.0009**	.0002	.013	.018	1.373*	.645	.953
7	Southern Pl.	− .055	− .005	.324	—[b]	—[b]	.00028**	.00005	−.004	.011	.522	.631	.932

[a] Regions 1 and 5 covered the whole period 1926–56; [b] Variable not included in this equation; [c] X_3 includedi n equations for regions 1, 3 and 7 and X_4 included in equations for regions 4, 5 and 6. Significance levels: **=1 per cent, *=5 per cent, and †=10 per cent.

the equations represented in Table 2, only very slight improvement was made in "explaining" fertilizer use variance (R^2 values), except in region 6. For this region, the linear equation gives lower standard errors of estimate, especially in the prewar period. Comparison between actual and predicted total fertilizer consumption is drawn in Figure 5. Because of lack of time, these statistics will not be explained further. This equation

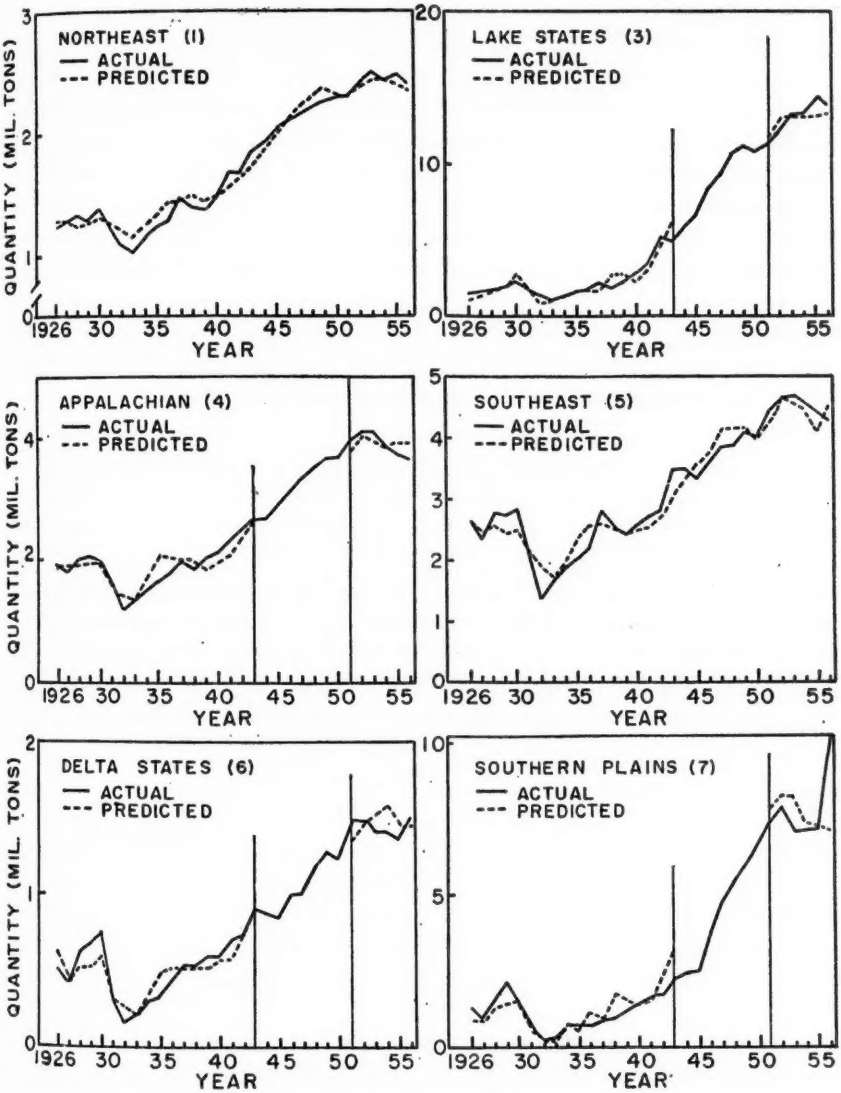

FIG. 5. COMPARISON OF ACTUAL AND PREDICTED USE OF FERTILIZERS FROM LINEAR EQUATIONS FOR REGIONS 1, 3, 4, 5, 6 AND 7, 1926-56.

would have resulted in a single prediction of great error for region 7, the southern plains, in 1956.

Other Variables and Approaches

Other studies have indicated the importance of variables which could not be included in this study.[3] Numerous linear programming, budgeting and survey studies for individual farm firms over the country indicate that profitable fertilizer use (the quantity which might well be demanded at various crop and fertilizer prices) depends on the amount of capital possessed by farmers; and, hence, what portion of it should be allocated to an investment alternative such as fertilization, as compared to livestock, feed, machinery, insecticides, etc. Hence, optimum allocations of funds to fertilizer depends on prices for, and production functions attached to, other inputs and products. The profitable amount of fertilizer also depends on the leasing mechanism used on a farm. Available time series data do not, however, allow convenient inclusion of these variables in regression models. Even, then, further statistics now being derived make it appear that predictions of fertilizer demand can be improved. The data presented should be looked upon as simple methodological steps in this direction. They have been presented in this light.

[3] M. A. Anderson, E. O. Heady, L. E. Cairns, and E. L. Baum, "The Appraisal of Factors Affecting the Acceptance and Use of Fertilizer in Iowa," 1953, Iowa Agricultural Experiment Station Special Report No. 16. 1956; E. O. Heady, G. W. Dean, and A. C. Egbert, "Analysis of the Efficiencies of Alternative Farm Leasing Arrangements" (an application of linear programming), Iowa Agricultural Experiment Station Research Bulletin 445, 1956; E. O. Heady, and E. W. Kehrberg, "Relationship of Crop-Share and Cash-Leasing Systems to Farming Efficiency," Iowa Agricultural Experiment Station Research Bulletin 386, 1952; E. O. Heady, R. McAlexander, and W. D. Shrader, "Combinations of Rotations and Fertilizer to Maximize Crop Profits on Farms in North-Central Iowa," Iowa Agricultural Experiment Station Research Bulletin 439, 1956; G. W. Dean, E. O. Heady, and H. H. Yeh, "An Analysis of Returns from Farm and Nonfarm Employment Opportunities on Shelby-Grundy-Haig Soils," Iowa Agricultural Experiment Station Research Bulletin 451, 1957.

COMMODITY ADVERTISING OF FARM PRODUCTS

Chairman: George Mehren, University of California

THE ADVERTISING AND PROMOTION OF FARM PRODUCTS—SOME THEORETICAL ISSUES[*]

Sidney Hoos
University of California, Berkeley

AMERICAN agriculture for a long time has had a propensity for slogans and symbols. During the past several decades, phrases as "equalize the tariff," "parity-price," "parity-income," "flexible price supports" have at various times been the rallying cry of farm groups. But such slogans have been more than emotional declamations; they have been closely tied to proposed or effectuated national programs and policies. Now, more and more segments of American agriculture are joining in the growing chorus of what may develop into another historic slogan for agriculture—a modernized triple-A—"Advertising Is Agriculture's Answer." Although not yet generally permissive under federal legislation, an increasing number of states in recent years have enacted enabling legislation for advertising and promotion of farm products by commodity groups. Such activities supplement those of regional and national trade associations as well as of cooperatives and private firms selling farm products.

It is not necessary to emphasize that advertising and promotion of agricultural commodities is not something new. What is relatively new, however, is the acceleration with which commodity groups, under state enabling acts, are turning to advertising as a vehicle for what they term "expanding the market." That such an approach is fraught with frustration for farm commodities plagued with chronic surplus need not be stressed; nor do I here discuss that problem. Also, I do not consider the normative and welfare aspects of advertising and the extent to which social waste is involved if indeed it is involved. To delineate further the area of discussion, we do not distinguish between "informative" and "persuasive" advertising, a not very useful dichotomy which reminds one of the scholastics distinguishing between legitimate interest and illegitimate usury. Further, we do not discuss problems of statistical analysis and measurement.

Our discussion is limited to some theoretical issues bearing on advertising and promotion from the view of economic analysis of the firm and industry. We are interested in surveying the present status of integrat-

[*] Giannini Foundation Paper No. 174.

ing advertising into theories of the firm and industry, and the direction of some current and potentially promising work along that line. To the extent we tangentially comment on other issues, it will be to illustrate or to supplement theoretical issues bearing on advertising by the firm or industry.

The economic analysis of advertising and promotion (often lumped under "selling costs," by some writers) is of relatively recent origin. Pre-Marshallian economists were, of course, aware of advertising, but they did not deal with it analytically. Marshall, himself, lists "advertisement" in the index to his *Principles of Economics,* but in the text there is little about it of consequence in an analytical sense. (Yet, I would not be surprised if some scholar were to point out a footnote or Appendix Note which might be interpreted so that again one could exclaim, "It's all in Marshall!") In his *Industry and Trade,* Marshall distinguishes between what we now call "informative" and "persuasive" advertising, but he does not develop them into an integral part of his theme. Pigou, in *Economics of Welfare,* set forth a broad framework for considering the social and welfare aspects of activities such as advertising; but he also did not articulate a theory in which advertising was integrally incorporated. It was not until after the famous 1926 paper of Sraffa and those following it by other writers that the stage was set. But Mrs. Robinson in the *Economics of Imperfect Competition,* shied away from the task; and it is to Chamberlin's *Monopolistic Competition* that credit must be given for breaking the barrier and, for the first time, for developing a theory of the firm which incorporates in a meaningful way selling costs including advertising and promotion.

Chamberlin's solution, however, was not a general one even within his own framework. He noted the necessary conditions for short-run profit maximizing when price and output are assumed fixed with selling costs variable, or when output and selling costs are assumed fixed with price variable. He recognized that a more complete solution involved simultaneous variation in price, output, and selling cost, but he commented on the equilibrium adjustment rather than developing it. It was not until further progress by Barford, Boulding, Buchanan, Stigler, Dorfman and Steiner,[1] among others, that a more general analysis was developed so that with price, volume, quality, and selling costs each being variable, a short-run profit maximizing solution became available.

---

[1] Borge Barford, "The Theory of Advertising," Abstract in *Econometrica,* July, 1940, p. 279; Kenneth Boulding, *Economic Analysis,* Rev., New York: Harper & Brothers, 1948; Norman S. Buchanan, "Advertising Expenditures: A Suggested Treatment," *Journal of Political Economy,* August, 1942, p. 537; George Stigler, *The Theory of Price,* New York: Macmillan Co., 1946; and Robert Dorfman, and Peter O. Steiner, "Optimal Advertising and Optimal Quality," *American Economic Review,* December, 1954, p. 827.

This is the stage reached by the conventional treatment of advertising as incorporated into the theory of the firm. Such treatment of selling costs in the theory of the firm suffers from some serious shortcomings; for example, assumptions of a profit-maximizing firm operating under certainty in a static, monoperiodic, single-product setting. Such assumptions not only suggest some theoretical issues which require consideration in the analysis of selling costs but which require relaxation if economic theory is to serve as a basis for more meaningful and productive empirical research on the role and effects of advertising in the operation of the firm and industry.

A serious question is involved in the economic analysis of advertising and promotion; that is, the lack of an anchor to which to tie the analysis. The theoretical developments sketched earlier, as well as most treatments of advertising, generally assume, explicitly or at times implicitly, that increased sales occur along with increased selling costs. Yet, the basis for such an assumption is questionable. Samuelson has shown that even under monopoly there is no unique effect on equilibrium output or price when selling cost is introduced. After his proof, he writes, "Thus, the direction of change of output depends upon the direction of shift of the marginal revenue schedule (upward and downward) as advertising changes. Now, there is nothing in the formulation of the problem which requires that this shift be of any particular direction. Hence, short of quantitative empirical investigation of sales responses to advertising no presumption is possible. . . . It is not possible, therefore, to state whether output will be larger or smaller under positive advertising expenditures as compared to no advertising expenditure. It may be pointed out that the effect of advertising upon price is also incapable of unambiguous inference. . . ."[2] When other forms of market structure are introduced, the issue is even more pertinent.

In the analysis of production, we lean on technological considerations which suggest the nature of the productivity functions; and when demand is theoretically dealt with, we lean on the "law of demand" with its *ceteris paribus* negative relation between price and quanity. At the macrolevel, we can posit a positive relation between aggregate consumption and income. But we have no technological or psychological considerations which logically impel us to accept a particular directional relation of selling costs to output or price. Within the frame of profit maximizing by the firm, we can say only that if advertising costs are incurred, the demand curve may shift so that, compared with the previous equilibrium situation, either a larger quantity may be sold at the same price, the same quantity sold at a higher price, a larger quantity sold at a lower price, or a smaller

[2] Paul A. Samuelson, *Foundations of Economic Analysis*, Cambridge: Harvard University Press, 1947, pp. 41-42.

quantity sold at a higher price. Such a range of permissible outcomes can be expected to be uncomfortable for the economist but alarming to farm commodity groups already convinced of the inevitably favorable results of advertising and promotion.

From the view of the economic principles involved, there is the added question as to whether there is something unique about advertising and promoting farm products compared with nonfarm or industrial products. Most farm products are generally recognized as being relatively inelastic in demand with respect to price, as having a relatively low elasticity of demand with respect to income, and relatively high cross elasticities of demand with respect to prices of a wide range of products. Associated with these demand characteristics is the fact that, in our society with its mores and institutions, "the human stomach is highly inelastic" as evidenced by the stable per-capita disappearance of food in terms of poundage. These aspects lead to the view that population and its age distribution are the variables which primarily determine the level of aggregate food consumption and that increased per-capita consumption of particular foods is highly sensitive to the substitution principle. Whether this raises distinctive issues about advertising food products, however, is another question.

One can build a case that, in terms of economic principles and analysis, advertising and promotion of farm products do not essentially differ from industrial products. Yet, there is the point that, because of the high substitution effects, the economic analysis of advertising of farm products calls for particular attention to the interproduct, interfirm, and interindustry relationships. The competitive advertising reactions among industries whose products are close substitutes require that the advertising reaction effects be explicitly reflected in the analysis. A beginning in that direction has recently been made through the use of game theory.[3]

A model which includes the competitive advertising reaction should explicitly reflect the behavior of the reaction function. Yet, business organizations have little, if any, such knowledge and must operate on conjecture. However, this difficulty is essentially the same as the one noted earlier about the *a priori* effects of advertising on equilibrium output and price and may not be viewed as more damaging, at the conceptual level, than many other assumptions conventionally made in partial equilibrium analysis. Knowledge gained from quantitative empirical research is the alternative; hence, a significant issue is the formulation of theoretical models which may serve as a logically valid conceptual underpinning of the empirical investigation and suggest fruitful lines of approach and meaning-

[3] Lawrence Friedman, "Game-Theory Models in the Allocation of Advertising Expenditures," *Operations Research*, September-October, 1958, p. 699.

ful hypotheses to be tested empirically.

If we put aside the measurement problem and consider theoretical aspects of advertising which can be incorporated into partial equilibrium firm theory, a catalogue of suggestions can be compiled. If, for example, we limit ourselves to a single-product, profit-maximizing firm which advertises and which is concerned with a single period under certainty and which borrows funds to supplement its own capital and also makes outside investments, the equilibrium static solution can be stated in the following necessary marginal conditions: output, advertising expenditure, investment in the firm's own operation, and the firm's outside investment are carried to the point where the firm equalizes its marginal rate of internal return, marginal rate of advertising return, marginal interest rate of borrowing, and marginal interest rate of outside investment.[4] This type

[4] The skeleton model is briefly indicated as follows: From the technical production function, cost functions of the productive services, cost function of the selling-cost service, and the product demand function facing the firm, the functional relations (1), (2), and (3), below, are derivable by the usual methods; the fuctional relations (4) and (5) are assumed known by the firm; and (6) reflects the firm's own capital.

(1) Product output $= Q = f_1 \ (C, v)$, where $C \equiv$ production costs and $v =$ other variables.
(2) Total sales revenue $= E = f_2 \ (Q, P, w)$, where $Q \equiv$ product output, $P \equiv$ product price, and $w =$ other variables.
(3) Total selling input $= q_s = f_3 \ (S, x)$, where $S \equiv$ total selling costs, and $x =$ other variables.
(4) Interest rate on borrowed funds $= i^L = f_4 \ (L, y)$, where $L \equiv$ funds borrowed, and $y =$ other variables.
(5) Interest rate on outside investments $= i = f_5 \ (I, z)$, where $I \equiv$ funds invested outside the firm and $z =$ other variables.
(6) Firm's own capital $\equiv K$, a constant for the period.

The firm's objective is to maximize $R = E + i^I I - i^L L - C - S$, subject to $F = K + L - C - S - I = O$ being a constraint restricting the variation of L, C, S, and I. Let $G = R - \lambda F = E + i^I I - i^L L - C - S - \lambda(K + L - C - S - I)$; λ being a Lagrangian multiplier.

$$\frac{\partial G}{\partial C} = \frac{\partial E}{\partial Q}\cdot\frac{\partial Q}{\partial C} - 1 + \lambda = 0; \frac{MR_Q}{MC_Q} - 1 + \lambda = 0; \frac{MR_Q - MC_Q}{MC_Q} + \lambda = 0; \cdots r_m = -\lambda$$

$$\begin{bmatrix} MR_Q = \text{marginal revenue from sale of } Q \\ MC_Q = \text{marginal cost of } Q \text{, exclusive of interest cost} \end{bmatrix}, \left[\frac{(MR_Q - MC_Q)}{MC_Q} = r_m\right]$$

$$\frac{\partial G}{\partial I} = \frac{\partial i^I I}{\partial I} + \lambda = 0; \ i^I(1 + \epsilon_i{}^I) + \lambda = 0; \cdots i^I{}_m = -\lambda$$

$$\left[\epsilon_{iI} = \frac{\partial i^I}{\partial I}\cdot\frac{I}{i^I}\right], \ [i^I(1 + \epsilon_{iI}) = i^I{}_m].$$

$$\frac{\partial G}{\partial L} = \frac{-\partial(i^L L)}{\partial L} - \lambda = 0; \ i^L(1 + \epsilon_{iL}) + \lambda = 0; \cdots i^L{}_m = -\lambda$$

$$\left[\epsilon_{iL} = \frac{\partial i^L}{\partial L}\cdot\frac{L}{i^L}\right], \ [i^L(1 + \epsilon_{iL}) = i^L{}_m]$$

of solution suffers from the same shortcomings as those of the Buchanan and Dorfman and Steiner models, except that here borrowing and investment are explicitly reflected. The borrowing and investment issue merits emphasis because firms do borrow funds to make advertising expenditures and because in a sense advertising may be viewed as a form of investment—different from capital or usual investment in that advertising investment is intended to affect present and future demand for the product while plant and equipment investment is directed to affect the volume and character of output and supply.

A worth-while objective is to generalize further the above model so that it explicitly includes influences of multiple products, joint costs and revenues, on a polyperiodic basis with uncertainty, and with borrowing and various types of investment including that made outside the firm as well as advertising investment distinguished from other types. This can be done on a conceptual level, but whether the model would be operationally manageable for empirical investigation is a moot point.

In the literature on advertising and promotion, it is usual to distinguish between "production costs" and "selling costs," although various writers do not agree definitionally. On this point it may be pertinent to recall what Frank Knight wrote in 1921, ". . . the 'production' of wants is like the production of goods . . . the advertising, puffing, or salesmanship necessary to create demand for a commodity is causally indistinguishable from a utility inherent in the commodity itself."[5] Following that theme, it may be necessary to articulate more sharply the definition of "a product," recognizing the difference between output as it is physically generated by the conventional production function and "the product image" as it is viewed by the consumer subject to advertising, promotion, and the crafts of "the hidden persuaders." If the consumer's image of the product is accepted as the essential one to be concerned with, the conventional production function might be modified so that it includes advertising and promotion inputs along with the usual types of inputs. Then, the analysis can be carried forward along the established lines of marginal

---

$$\frac{\partial G}{\partial S} = \frac{\partial E}{\partial q_s} \cdot \frac{\partial q_s}{\partial S} - 1 + \lambda = 0; \frac{MVP_s}{MC_s} - 1 + \lambda + 0; \frac{MVP_s - MC_s}{MC_s} + \lambda = 0; \cdots r_s = -\lambda$$

$$\left[\begin{array}{ll} MVP_s & = \text{marginal value product of selling service s} \\ MC_s & = \text{marginal cost of selling service s, exclusive} \\ & \quad \text{of interest cost} \end{array}\right], \quad \left[\frac{MVP_s - MC_s}{MC_s} = r_s\right]$$

The necessary maximum condition is, therefore, $r_m = i^I{}_m = i^L{}_m = r_s$ where $r_m =$ marginal rate of internal return, $i^I{}_m =$ marginal interest rate on outside investments, $i^L{}_m =$ marginal interest rate on borrowed funds, and $r_s =$ marginal rate of advertising return.

[5] Frank H. Knight, *Risk, Uncertainty, and Profit*, Boston and New York: Houghton Mifflin Co., 1921. London School of Economics Reprint Series, p. 339.

productivity theory to derive equilibrium values for output and price of "the product" and optimum utilization of the services including those reflecting advertising and promotion. But the marginal productivity functions of advertising and promotion would be assumed known or derivable as are those of other services in the production function. To one who is interested in theory only, that is not an unusually heroic assumption. But those who have labored over the empirical estimation of even conventional production functions might shudder at the thought of empirically deriving marginal productivity functions for advertising and promotion. Advertising alone includes consumer and trade advertising; while promotion includes consumer deals, premiums, coupon offers, menu-related item promotions, contests, sample and demonstration programs, special displays, various trade deals, and special promotion associated with the introduction of new products. Nevertheless, it is necessary for us to learn more about revenue-cost relationships among the various advertising and promotion media.

It is Chamberlin's distinction between "selling costs" and "production costs" which is most widely followed. He wrote, "Selling costs are defined as costs incurred in order to alter the position or shape of the demand curve for a product." Contrasting the two types of costs, he says, "Those made to adapt the product to the demand are costs of production; those made to adapt the demand to the product are costs of selling."[6] But the problem here is again one of specifying what is a "product" or the same type of problem referred to by Knight.

Kaldor proposes that, "Selling costs are a phenomenon that emerges as a result of joint pricing . . . selling costs are the excess of the total expenditures actually incurred at all stages of the chain of production and distribution, over the amount that would have been incurred, if all separate services performed in the course of the productive and distributive process had been priced separately."[7] That view follows the one that "advertising is a particular case of subsidized commodities (commodities sold below cost) and the economic motive for the subsidy is always the expected consequential increase in the demand for complementary goods and services." Following that theme, one might suggest that a price discrimination model could be applied to analysis of advertising and promotion. But the conventional price discrimination model with its assumed independent outlets would be inadequate; it would be necessary to use a more general theory of price discrimination with related products and

[6] Edward Chamberlin, *The Theory of Monopolistic Competition*, 3rd Ed., Cambridge: Harvard University Press, 1938, p. 125.

[7] Nicholas Kaldor, "The Economic Aspects of Advertising," *Review of Economic Studies*, Volume 18, 1949-50, p. 1.

interdependent costs and revenues for various productive and distributive services. A somewhat similar model would be applicable to the common situation where food processors produce and sell, say, canned peaches or margarine, under a nationally advertised label and also for distribution under a private nonadvertised label. Here, we touch upon an intense struggle between nationally advertising processors and chain stores or cooperative buying organizations who handle and sell the national labels as well as their own private labels, a problem with overtones of multiple products, horizontal and vertical integration, as well as advertising, procurement, and pricing policies.

Another theoretical issue bearing on the economic analysis of advertising and promotion involves the time distribution of the demand effects which result from advertising. It has long been recognized at the descriptive level that promotion inputs may have an effect on demand in subsequent periods in addition to or in place of the period when the promotion is injected. Some theoretical work has been done on the analysis of distributed lag effects of advertising expenditures by Jastram.[8] By assuming lagged distributions of sales revenue over time generated by given advertising expenditures, he derives a revenue multiplier for advertising. He also develops, in a comparable way, a cost multiplier for advertising. Then, he derives the conditions for the rate of advertising expenditures to maximize the profit of a planned advertising operation. The model is a simple one, yet contributes meaningfully to the theoretical analysis of advertising expenditures. Now that it has been shown that a distributed lag function can be included in the analysis of advertising, subsequent steps remain. One of these is consideration of the alternative types of lagged distributions and their effects; another is to integrate the distributed lag analysis with the type of simultaneous solution multivariable problem treated by Barford, Buchanan, and others.

The recent revival of interest in distributed lags for the analysis of investment and demand, the work of Koyck[9] and Nerlove[10] following the early contributions of Irving Fisher, suggests that from the views of both theory and empirical investigation further progress may be at hand in the analysis of selling costs including advertising and promotion. Also, if one were to derive an advertising investment accelerator relation to couple with an advertising demand multiplier, further light might be thrown on

[8] Roy W. Jastram, "A Treatment of Distributed Lags in the Theory of Advertising Expenditure," *Journal of Marketing*, July, 1955, p. 36.

[9] L. M. Koyck, *Distributed Lags and Investment Analysis*, Amsterdam: North-Holland Publishing Co., 1954.

[10] Marc Nerlove, "Distributed Lags and Demand Analysis for Agricultural and Other Commodities," U. S. Department of Agriculture, Agricultural Marketing Service, Agricultural Handbook No. 141, June, 1958.

the interaction between demand and advertising investment expenditures. In this way, distributed lag functions could contribute further to the theoretical analysis and the empirical measurement of advertising effects.

The models presented in the literature on the analysis of selling costs are based on or assume a profit-maximizing firm. But in the wake of the marginal analysis controversy in the early postwar years, after the Hall and Hitch and other Oxford contributions lay dormant during the war years, the realism and analytical validity of the short-run, profit-maximizing principle were seriously questioned. Despite such doubts, however, an analytically acceptable alternative to the profit-maximizing principle has not been forthcoming. Full cost, conventional markups, and similar pricing procedures remain behavior rules without an analytical foundation. In advertising and promotion, a similar situation prevails. Available evidence indicates that firms generally allocate a certain percentage of a recent period's sales or the projected period's anticipated sales value as the advertising budget. Such procedure makes advertising expenditures sensitive to and positively correlated with temporal variations in demand. Further, it can be shown that such procedure is only by accident consistent with advertising expenditures called for by profit-maximizing principles. This does not, of course, vitiate the usefulness of profit-maximizing theories of selling cost and advertising expenditures. But it does suggest that consideration might be given to the development of selling cost theory in terms of a firm whose objective is optimization in the sense of the viability and participation concepts as used by Herbert Simon[11] in organization theory. It is of interest, however, that there is work going on in some business firms to devise methods to tie advertising expenditures directly to the profit criterion.[12]

Conventional procedures of establishing advertising budgets as some percentage of sales raises another issue. Many firms judge the success of their advertising, pricing, and product policies in terms of the share-of-market criterion. But here again there need be no unique relation between the profit position of the firm and its market share. Yet, there is much to the market share concept which requires clarification with respect to advertising and selling costs. It may be that here is a linkage between the firm and industry—with a logically acceptable definition of products of monopolistically competitive sellers—for economists have possibly more evaded than answered Triffin's points about whether the industry concept is meaningful under monopolistic competition.

---

[11] H. A. Simon, "A Comparison of Organization Theories," *Review of Economic Studies*, Volume 20, 1952-53, p. 40; James G. March, and Herbert A. Simon, *Organizations* New York: 1958.

[12] "A Profit Yardstick for Advertising," *Business Week*, November 2, 1958.

There are many other theoretical issues which merit attention. Time, however, permits here only listing a few. One is further consideration of the assets-liabilities approach to the theory of the firm,[13] following Boulding, in view of the thought that the buyer attitudes toward products and brands created by advertising and promotion may be classed as an intangible asset of the firm. Another issue concerns the inventory management area. In products manufactured from seasonal agricultural crops, companies with nationally advertised labels have a different type of inventory problem than do private label packers; the former are faced with the need to control inventory and flow to market so that year-end out of stock positions do not occur on retailers' shelves. In some food product industries, a single nationally advertising firm acts as a "promotion leader." This suggests a model of "advertising leadership and the dominant firm" along the general lines of the "price leadership and dominant firm" model. We need to understand why it is not unusual that a firm which has market dominance with a particular highly advertised branded product cannot carry over its market acceptance to another product sold under the same brand label.

In agricultural as well as industrial products, there are growing, stable, and declining industries. No consideration has been given, of which I am aware, to the different types of advertising and promotion problems facing such industries of varying trend. Faced with the apparent fact of secular declining per-capita consumption, which seems to be the case with some of the fresh deciduous or dried fruit industries, what real contribution can advertising and promotion make? This type of problem leads to long-run issues, whereas practically all of the work done in the analysis of selling costs is oriented toward the short run. There still remains to be answered the old question as to the relative effects, in a Marshallian long-run sense, of price variation and advertising as influences on demand and output.

In considering these issues and others of the type sketched earlier, one may wonder whether Sherrard had a point in writing, "as deliberate product differentiation, advertising and salesmanship take the center of the stage, economic theory in the traditional sense must depart. A revolution in analysis is called for . . . a new set of questions, a new philosophical foundation."[14] My own view is more sanguine. Actually, revolutions in analysis do not occur in economic theory. Rather, it slowly but persistently progresses in an evolutionary way as we face up to and struggle with changing and challenging issues and problems.

[13] Kenneth Boulding, *A Reconstruction of Economics*, New York: John Wiley and Sons, Inc., 1950.

[14] Alfred Sherrard, "Advertising, Product Variation, and the Limits of Economics," *Journal of Political Economy*, April, 1951, p. 126.

Among the many further theoretical issues that could be considered in connection with advertising and promotion, I briefly comment on only one more. This pertains to what we call the consumer's preference structure, a concept which is loaded with vexing and perplexing issues. What is the nature of the consumer's rationality and the ordering of his preference structure that it is deemed so passive and sensitive to advertising and promotion influences? Students of society, over the years, have vacillated between the "rationality" of man and his being swayed by "irrational" influences. A recent view is that of Aldous Huxley who states, "Human beings are a good deal less rational and innately just than the optimists of the eighteenth century supposed. On the other hand, they are neither so morally blind nor so hopelessly unreasonable as the pessimists of the twentieth century would have us believe—men and women are decent enough and sensible enough to be entrusted with the direction of their own destinies."[15] Brooks Atkinson is sufficiently concerned that he asks, "Will we meekly submit to the cant of mass culture with which advertising and promotion are saturating the nation?"[16] This apprehension over advertising was strongly expressed more than 50 years ago—long before advertising assumed its present proportions—when Graham Wallas wrote, "Every newspaper and magazine now contains evidence that advertising writing has become a profession suitable . . . for 'sons of gentlemen.' Young men of good education, naturally warm feelings, and that delicate sense of the emotional effect of words which, under different circumstances, might have made them poets, are now being trained as convincing liars, as makers, that is to say, of statements, to whose truth they are indifferent, in such a form that readers shall subconsciously assume the personal sincerity of the writer."[17] One may wonder what Graham Wallas might have thought about today's "hidden persuaders."

How stable can consumers' preference structures be if they are as subservient to advertising and promotion influences as some people seem to believe? Or perhaps the consumer is not, after all, servile. So concludes William H. Whyte when he observes that, "For years manufacturers have loved to say that the consumer is their boss. Now some of them might like to eat their words. He really is."[18]

Yet, there still remains the point that economists have really little understanding of the consumer's preference structure. We assume that it is given to us, taking it as it is without serious question as to its origin or

---

[15] Aldous Huxley, "Tyranny Over the Mind," *Newsday*, May 31, 1958.

[16] Brooks Atkinson, *New York Times Book Review*, November 2, 1958. (Cited in advertisement of *More in Anger* by Margo Mannes.)

[17] Graham Wallas, *The Great Society*, New York: Macmillan Co., 1914, p. 129.

[18] William H. Whyte, "The Web of Word of Mouth," *Consumer Behavior*, editor, Lincoln H. Clark, Volume II, New York: New York University Press, 1955, p. 113.

innate characteristics. Some of us have been so preoccupied with ordinal and cardinal measurement of utility, with integrability of preference fields, or with compensatory variation, that very likely inadequate attention has been given to some basic questions concerning the origin, stability, and real meaning of consumer preferences. One may respond that such questions are outside our province, that they are matters for psychologists, sociologists, or even psychiatrists. Be that as it may, one may wonder how much economists and students of marketing can really understand the consumer's buying behavior without further clarification of his preference structure. Perhaps, this is an area for effective interdisciplinary cooperation; or, perhaps, we will be forced to go forward on our own—as has occurred in the area of production functions which we are deriving empirically so as better to understand what is involved rather than assuming, as was previously done, that they are given to us by engineers and technologists. In either event, a better understanding is required of "the thing" we call consumer preferences reflected by the "utility surface."

In the treatment of individual consumer demand, the economist uses utility analysis which "rests on the fundamental assumption that the individual confronted with given prices and confined to a given total expenditure selects that combination of goods which is highest on his preference scale."[19] But, one may ask, how stable is the consumer's "preference scale"; to what extent is it subject to change from such influences as advertising and promotion?

One may wonder whether it would be fruitful to view the consumer's preference scale as being composed of "permanent" and "transitory" components, using Friedman's terminology in his permanent income hypothesis.[20] The permanent component of the consumer's preference scale would reflect the hard core preferences, relatively stable over time, while the transitory component would reflect the temporary and relatively high variable preferences. One might posit that the permanent component is based on the cultural and institutional influences, while the transitory component is based on more of the short-run and evanescent situations in which the consumer finds himself. This view of "permanent" and "transitory" preference is one which may make an understanding of the nature and behavior of the consumer's preference scale more meaningful. This is my conjecture, not yet refined, in contemplating what underlies "impulse buying" to which much advertising and promotion is directed.

It is true, of course, that influences other than advertising and promotion affect consumer preferences whether they be permanent or transi-

[19] Samuelson, *op. cit.*, pp. 97-98.

[20] Milton Friedman, *A Theory of the Consumption Function*, National Bureau of Economic Research, Princeton: Princeton University Press, 1957.

tory. This is particularly so in connection with new products—new in a more basic sense than, for example, a different colored label—new in the sense that frozen orange concentrate or concentrated fresh milk were upon their introduction. In his model on the growth of demand for new products, Duesenberry shows how the existence of interdependent preferences among individuals coupled with a lagged shift in preferences can account for a self-generating growth in demand.[21] One of the effects of advertising, however, may be the establishment and strengthening of the interdependence among preferences of consumers.

In discussing "our preoccupation with more and more consumer goods," a propensity influenced by consumer preference interdependence and the tendency toward emulation, Galbraith questions "two broad propositions" on which, he says, is based "the theory of consumer demand, as it is now widely accepted."[22] "The first is that the urgency of wants does not diminish appreciably as more of them are satisfied. . . . The second proposition is that wants originate in the personality of the consumer . . . they are given data for the economist." Galbraith's questioning of the first proposition can be interpreted as his reawakening to the fact that the marginal utility of money need not be constant, as those familiar with the assumptions of Marshallian static demand theory have long recognized. But I suspect that the theory of individual consumer demand would be scarcely altered in its essential characteristics if the Marshallian assumption of the constancy of marginal utility of money is dropped. His questioning of the second proposition is a literary statement of our earlier point concerning the origin and nature of the consumer's preference scale. Although he does not impute to advertising outright the blame for our preoccupation with more and more consumer goods, he does question our preference scale which is subject to influences certainly including advertising.

Even if we accept the view that there remain to be resolved a good many theoretical issues bearing on advertising and promotion, there is still the additional question of relevancy for farm products. In that respect we are here concerned with industry or commodity-group advertising and promotion of the type currently expanding under state enabling acts[23] or

---

[21] James S. Duesenberry, *Income, Saving, and the Theory of Consumer Behavior*, Cambridge: Harvard University Press, 1949, pp. 104-110.

[22] J. K. Galbraith, *The Affluent Society*, Boston: Houghton Mifflin Co., 1958, pp. 143-144.

[23] See report by National Association of Marketing Officials, Committee on Market-Services and Promotion of Agricultural Products (October 13, 1958); and Sidney Hoos, "The Contribution of Marketing Agreements and Orders to the Stability and Level of Farm Income," *Policy for Commercial Agriculture, Its Relation to Economic Growth and Stability*, Joint Economic Committee, 85th Congress, 1st Session, Joint Committee Print. November 22, 1957.

the sponsorship of farm commodity associations. Examples of the latter are numerous, a few of which are the well-known American Dairy Association, American Meat Institute, National Poultry and Egg board, National Peach council, Tea Council of the U.S.A., and the Pacific Coast Canned Pear service. The California Cling Peach Advisory board and the California Wine Advisory Board as well as the Washington Apple commission and the Florida Citrus Commission can serve as examples of operation under state legislation. In addition there are the long-established and substantial national advertising programs of marketing cooperatives such as Sunkist Growers and Diamond Walnuts. In addition to large private firms such as Del Monte (California Packing Corporation) and General Foods, the number of industry or farm-commodity groups having advertising and trade promotion possibly runs into the hundreds with aggregate expenditures of many millions of dollars annually.

The meat industry alone was recently urged to sponsor a "stepped-up . . . promotional campaign" supported by "possibly a half-mil-per-pound levy which would realize about $13,700,000."[24] The report continues, "the effect on retail meat prices of a half-mil-per-pound would be only (sic) about three-quarters of a mil per pound." Another way to put it is that, assuming the volume would not be affected, the increased expenditures by consumers for meat and its products would amount to over $20,500,000 annually. But what kind of imputation is that of the effects of the projected increase in the consumer price? Some of the unresolved theoretical issues noted previously lead to the conclusion that we now have inadequate bases even at the conceptual level, not to mention the empirical measurement problems, to determine the short-run and, even more so, the long-run effects on price and volume from advertising and promotion expenditures.

Despite the types of questions and issues raised here, however, one can expect farm-commodity groups to continue and even increase their interest in and the use of advertising and promotion. Such activities, I must assume, will continue to rest more on faith than on fact. As the national advertising and promotion bill for all goods and services continues to increase at the rate of nearly one billion dollars a year, and now approximates 10 billion dollars annually (more than three times as much as is spent annually on higher education in this country), farm-commodity groups are likely to follow the trend.

One might ask, why cannot farm-commodity groups exploit potential scale economies in promotion to obtain larger profitable volume, as do some of the large private firms analyzed by Bain?[25] I doubt that there is

[24] *Food Field Reporter*, October 13, 1958.

[25] Joe S. Bain, *Barriers to New Competition*, Cambridge: Harvard University Press, 1956.

an unequivocal answer, but I suspect that the situation is different. Large private firms with differentiated products are in a position to coordinate their price, output, and promotion and are partially protected by various barriers to entry. Farm groups promoting under state enabling acts or commodity associations which advertise do not have barriers to entry, nor are most of them in a position to coordinate their promotion activities with output and price which in turn are influenced by the independent decisions of the many individual farms or firms which compose the group or association. Thus, the reasoning applied to a large private firm does not necessarily carry over to a group of farmers who integrate only their promotion activities.

In closing, I should emphasize that I do not insist that advertising and promotion of farm products by groups of farmers is futile. Neither do I say that such activities should be decreased or eliminated. My theme is that presently there are too many unresolved conceptual or theoretical issues to be able really to answer simple questions increasingly being asked by many farm-commodity groups—"Should we promote and advertise and, if so, how? And, especially, exactly how much should we invest in advertising, and *will it pay off*?"

As we progress in our theory and in our measurement, we can look forward with some confidence to possible answers not only to general problems raised by advertising and promotion policies, but also to their applicability to farm products. Our concern, however, must not be so focused on the technical measurement of advertising effectiveness that we neglect to investigate the more basic economic and policy questions raised by the very use of advertising and promotion.

NEEDED RESEARCH ON THE EFFECTIVENESS OF FARM PRODUCTS PROMOTIONS

FREDERICK V. WAUGH
United States Department of Agriculture

FARMERS are becoming interested in the possibilities of promotion and advertising.

Of course, this interest is not entirely new. For several decades, farm products have been advertised and promoted not only by processors and distributors, but also by farmer-cooperatives, trade associations, and occasionally by state governments. Farm groups have had some interest in programs of this kind. But their main interest has been in the efficiency of production and to a considerable extent in the efficiency of marketing. Until recently the typical farmer did not concern himself a great deal about the "demand creation."

This situation is rapidly changing. The enormous surpluses of farm products in recent years, together with the desire to avoid effective production controls, have dramatized the need for expanding markets for farm products. To some extent this can be done by subsidies such as those now being used to expand exports and to divert surplus farm products into lower-order uses. But the American farmer needs, and knows he needs, to find bigger, commerical, nonsubsidized markets for his products.

This is probably the main reason for the current interest in so-called "self-help" programs, such as those proposed by the dairy and turkey industries. One feature of these proposals is a sort of check-off system through which (if a majority of the industry approved) each farmer would be compelled to contribute to a fund to be used for research, advertising, and promotion. A promotional program for wool and lamb is already under way, financed by funds withheld from the payments made to sheep producers under the Wool Act.

What kind of research in promotion does the farmer most want and need? I believe his main interest at present is in economic research, rather than in psychological research. Specifically the farmer wants solid statistical facts about the costs of various kinds of promotion, and about their dollars-and-cents effects upon farm income.

Psychologists have been doing a lot of exciting work in motivation research and depth interviewing.[1] Doubtless this kind of research is glamorous, and profitable to advertisers. It could greatly change consumer demands and methods of food marketing. But my own personal belief is that most of the basic trends in consumer preferences for food are desir-

[1] Vance Packard, *The Hidden Persuaders*, New York: David McKay, Inc., 1957.

able—benefiting both consumer and farmer. We don't need to hypnotize consumers into thinking they should go back to more cereals and potatoes at the expense of fresh vegetables and meat; nor that they ought to go back to fat pork, rather than lean. The farmer's main interest is not in research intended to induce the consumer to buy food she doesn't want and need. Rather, it is in finding kinds of promotion that will expand the market for existing farm products in ways that increase the farmer's net income.

Unfortunately, few agricultural economists have attempted to measure the effectiveness of promotional programs in agriculture. The studies that have been made[2] have typically come to negative conclusions; that is, the authors report that they were unable to find concrete evidence that promotion and advertising had been profitable. But such results should not be taken as final. Statisticians and economists sometimes fail to discover basic facts either because their statistics are not accurate enough, or because they do not use the most appropriate methods. In any case, the farmer wants research that will give him the same kind of information as that his experiment stations give him on fertilizer. They tell him the yield of potatoes he can expect if he uses specific amounts of various fertilizer ingredients. They help him figure costs and probable returns. If the farmer is going to put his money into a big advertising campaign to increase the market for turkeys, he wants an objective estimate of what is likely to be accomplished. If that is not feasible, he will want to find out, after he has spent his money for a year or two, whether he should spend more or less or whether to forget the whole thing.

Advertisers, themselves, are well aware of the need for economic research. In October, the annual conference of the Advertising Research Foundation was devoted entirely to the question, "How Can Advertising be Better Evaluated in Today's Economy?" Serious attention was given to research intended to evaluate the costs of and returns from advertising and promotion. I attended this conference and was impressed with the progress reported by several corporations and advertising agencies.

I shall discuss economic research designed to measure three things: the decay curve, the demand curve, and the returns curve.

The Decay Curve

The concept of a decay curve is rather new in economics. The term itself is borrowed from physics, especially from the physics of radio-

---

[2] Joseph L. Apodaca, "Possibilities of Consumer Advertising of Fresh Fruits and Vegetables from a National Standpoint," Unpublished USDA Report, September 1, 1938. Alois F. Wolf, "Measuring the Effect of Agricultural Advertising," *Journal of Farm Economics*, May, 1944, pp. 327-347.

activity. Before considering advertising it might be well to consider briefly the decay curve for radioactive carbon-14, and the use of that curve in archeology.[3] Radioactive carbon-14 is found throughout the earth's atmosphere. It is absorbed by all living plants. Moreover, all animals, including men, eat either vegetable matter or other animal matter, and thus absorb carbon-14. All living vegetable matter and all living animal matter is thus radioactive. In fact, they all have the same charge as measured, for example, on a Geiger counter.

But as soon as a plant or animal dies it stops absorbing carbon-14 and starts to lose it by the process of disintegration or decay. In about 5,568 years after death, vegetable or animal matter has lost one-half of the original charge. Thus, the "half-life" or carbon-14 is 5,568 years. This decay goes on at a rate determined by a very simple formula. If one-half the charge is lost in 5,568 years, half the remaining charge will be lost in another 5,568 years, etc., ad infinitum. Thus, radioactivity never completely dies. It does, however, become weaker and weaker with the passage of time.

This theory has been checked in various ways. For example, we know at least the approximate dates when several of the Egyptian Pharoahs died. From this, the physicists can predict the amount of radioactivity that should remain in the wood used in building their coffins. Such predictions have been made and tested. They correspond very closely with the known lengths of time that have elapsed since the burial of several Pharoahs. In archeology, tests for carbon-14 are usually used the other way around. That is, usually the date is unknown and has to be estimated by the amount of radioactivity measured by sensitive Geiger counters. For example, the skull of an extinct form of bison was found a few years ago in Texas. Encased in its skull was an arrowhead indicating that the bison had been killed by a man. Archeologists had differed concerning the probable date that such a man was alive in North America. A careful measurement of the radiation left in the bone of the bison indicated that it was killed 9,883 years ago. The standard error of this measurement was something like 50 years. Thus, the evidence is that a man lived in North America almost 10,000 years ago.

All this is far removed from economics. Yet, several economists have struggled with a closely related problem—that of "distributed lags"—as Irving Fisher[4] called them. In recent years, Friedman[5] has found a distributed lag in the effect of past incomes upon the current demands of

[3] Ruth Moore, *Man, Time, and Fossils*, New York: Alfred Knopf, 1953, pp. 354-378.
[4] Irving Fisher, "Our Unstable Dollar and the So-called Business Cycle," *Journal of the American Statistical Association*, 1925.
[5] Milton Friedman, *A Theory of the Consumption Function*, Princton: Princeton University Press, 1957.

consumers. Nerlove[6] finds a distributed lag in the effect of past prices upon the acreage and yields of farm products. These economists found that the effects of past incomes and prices gradually diminish with time, and that the reduced effectiveness follows approximately the same law of decay as that found in physics.

Still more recently, Vidale and Wolfe,[7] and Alderson[8] have applied this same concept to a study of the effectiveness of advertising.

I believe the general concept of a decay curve may open up a big, new field of economic research designed to measure the effectiveness of advertising and promotion. Economists and statisticians may have been trying to measure the wrong thing. They have often looked for some relation between current advertising expenditures and current sales (or current profits). This seems appropriate only in the case of the most ephemeral types of advertising, such as the "week-end specials" advertised by food stores. Most advertising is effective for a longer time.

In fact, the recent studies mentioned above suggest that most old advertisements never die—they just fade away. Like an unused storage battery, an old advertisement gradually loses its charge. An advertising campaign may attract thousands of new customers, but if the advertising is stopped, some of these customers are likely to stop buying, perhaps lured away by the advertisements of a competing concern. Even those customers who continue buying may buy less frequently. For example, they may be enthusiastic about a new breakfast food for a while, but after a few weeks they may prefer a little variety.

Current sales and current profits do not depend upon current advertising expenditures. Rather they depend upon the "advertising charge;" in other words, upon the accumulated effects of past and current advertising expenditures.

Nerlove and I are working on a model based upon this concept of an advertising charge. I shall not discuss that model in detail today. But the general idea is illustrated in Figure 1.

The chart shows the relative effectiveness of an advertisement during several succeeding periods of time (say, months or years), on the assumption that from any period to the next, three-tenths of the effectiveness is lost. In other words, while the advertisement never dies completely, it is only 70 per cent effective after one year, $(0.7)^2\ 100 = 49$ per cent effective after two years—and, in general, it is $(0.7)^n\ 100$ per cent effective after n years.

---

[6] Marc Nerlove, *The Dynamics of Supply,* Baltimore: Johns Hopkins University Press, 1958.

[7] M. L. Vidale and H. B. Wolfe, "An Operations Research Study of Sales Response to Advertising," *Operations Research,* July, 1957.

[8] Wroe Alderson, "The Productivity of Advertising Dollars," *Cost and Profit,* February, 1958.

In this example, the decay rate is assumed to be three-tenths. This is only for purpose of illustration. In any particular case, the actual decay rate may be found to be close to zero—meaning very little loss in effectiveness over time; or it may be close to 1.0—meaning that practically all the effectiveness is lost in the first period. A key problem for economic research is that of measuring the actual decay rates for different kinds of promotional programs, and for different kinds of farm products.

The most obvious way of measuring the decay rate would doubtless be to induce some concern to stop advertising and promotion completely. This would enable the researcher to find out how long it took for the ad-

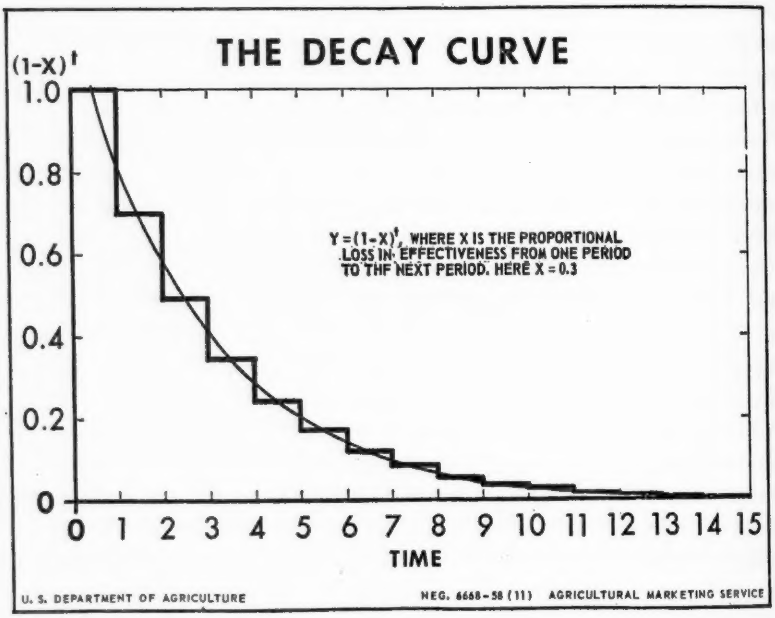

FIG. 1

vertising charge to run out—or perhaps, to measure what the physicist would call its "half-life"; i.e. the time it takes before it is half alive and half dead.

Apparently, Vidale and Wolfe had records of the dollar sales of certain companies that did stop advertising completely. But this is pretty strong medicine. It would be hard for the average businessman to swallow—and the advertising agency might not like the idea. In some cases guinea pigs are sacrificed to research, and canned foods must be destroyed to study their qualities. But we can hardly expect healthy businesses to sacrifice themselves on the altar of statistical research.

But, luckily, no such drastic step is necessary. I believe the statistician can measure the accumulated effects of advertising by methods very similar to those used by Fisher, Friedman, and Nerlove—in other words, by the use of distributed lags. But even this method will not work unless industry and advertising agencies can be induced to give up some of their most cherished customs and folklore.The statistician cannot measure the effect of advertising expenditures if they are kept at a fixed level—or even at a fixed percentage of gross profits. The statistician must have records that cover substantial variations in the advertising budget from time to time. Similarly, the statistician could never have measured the effects of fertilizer upon crop yields if the same applications of the same fertilizer were used on every plot of ground.

If the measurement of the economic effects of advertising are important, some businessmen must deliberately disregard much of the standard advice about a regular, stable advertising budget. They must purposely destabilize the budget—perhaps splurging one year and then letting up for a year or two.

Wherever there is substantial variation in promotional expenditures from year to year, or from month to month, the effects of these expenditures can doubtless be measured by techniques that are similar to those used in measuring the effects of past prices upon the acreage and yield of cabbage. This does not assume that all advertising has a positive effect. Our model must provide for cases of no effectiveness—even of negative effectiveness. The decay rate and the effectiveness are to be measured by actual data.

In my opinion, the main reason for the negative results obtained in some previous research in this area was that the researchers were looking only at the immediate, current effects—which typically are small in relation to the total effect. In our illustrative example, with a decay rate of 30 per cent, the eventual accumulated effect is three and one-third times as great as the initial effect. This is indicated by the fact that the total area of all the bars together is three and one-third times the area of the first bar alone. Suppose that a statistician found evidence that $2 worth of advertising returned only $1 worth of new business in the current year; the important conclusion would be that it would eventually return three and one-third dollars' worth of new business. Of course, there is nothing sacred about a decay rate of 30 per cent; if it were 20 per cent, the eventual effect would be five times as great as in the initial period.

Of course, the problem is complicated by the fact that dollar sales over a period of time are influenced by many factors in addition to promotion. They are affected by the growth of population, by changes in tastes, by consumer incomes, by supplies and prices of competing products, and so

on. But these are not fatal complications. Any statistician who analyzes economic trend series is confronted by these same complications. In other words, a realistic model for measuring the economic effects of promotion must include many other variables, such as those mentioned above. To fill in this model, the statistician can use the well-known techniques of least-squares regressions, or perhaps the more elaborate methods of structural analysis. And, whatever formal method he uses, he will do well to check his mathematical findings with practical men with experience in marketing and promotion.

Demand Curves

The economist is on familiar ground when talking about demand curves. Since the days of Cournot and Marshall, the economist's major stock in trade has been the demand curve, showing the quantities of some commodity that consumers would be expected to buy during a given period at a number of stated prices. The heavy line in Figure 2 represents such a demand curve.

The general purpose of advertising and other kinds of promotion is to change the demand curve for some commodity or service. The purpose often is to raise the curve so that consumers will either buy more at the same price or will pay a higher price for the same quantity. This is illustrated in the diagram by the line marked "curve raised."

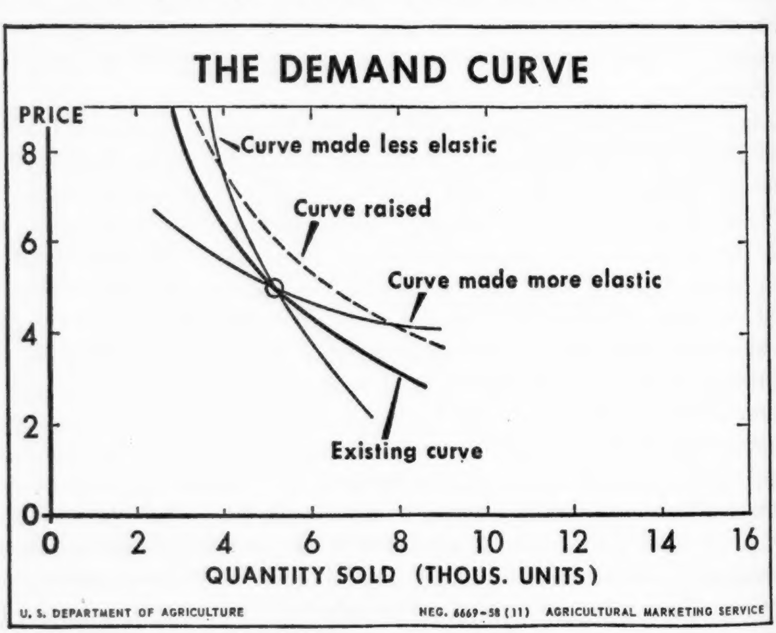

FIG. 2

Some years ago, Chamberlin[9] discussed another common aim in marketing—that of making the demand curve less elastic. Chamberlin discussed in some detail how this could be done through "product differentiation." Such differentiation commonly involves distinctive packages and trademarks, together with effective advertising, which induces consumers to buy the particular brand in question. By such means, the manufacturer and advertiser can commonly make the demand for his particular products less elastic than they were before his product was differentiated and advertised. Then and only then is it feasible for him to raise his prices, getting the premium above the general market level. Brand names are, of course, uncommon in the case of raw farm products. However, they are increasingly prevalent in highly priced packaged foods, as well as tobacco products and clothing.

So far as I know, economists have given very little attention to advertising and promotion intended to make the demand curve more elastic. Schultz[10] discussed this matter briefly and pointed out the benefits farmers would derive from any particular program that succeeded in increasing the elasticity of the demand for food. One of the problems confronting agriculture is that the demand for food is probably becoming less and less elastic as incomes rise. This accentuates the inherent instability in agriculture, and makes the farmer more and more dependent upon government supports of various kinds. However, some attempts are being made to make the demand for food more elastic. One example is the Plentiful Foods program of the Department of Agriculture. This program brings the consumer up-to-date information about those foods for which the supply is plentiful and prices low. The effect of it is to encourage greater consumption of any food as soon as its price drops. Much of the advertising by chain stores and supermarkets probably has the same effect. The emphasis of this advertising is not upon brand names and fancy packages. Rather, it is upon price. Price advertising doubtless tends to make demand more elastic.

The problem confronting the economist and statistician is how to measure the effectiveness of advertising and promotion as a means of changing the demand curve, whether raising it, making it less elastic, or making it more elastic. This is no easy task, partly for the reasons pointed out in connection with decay curves. But there are at least two possible ways of measuring this phenomenon.

First, the demand curve can well be built into a model that includes the decay curve. Thus, instead of measuring the effect of current adver-

---

[9] Edward Chamberlin, *Theory of Monopolistic Competition*, Cambridge: Harvard University Press, 1936.

[10] Theodore W. Schultz, *The Economic Organization of Agriculture*, New York: McGraw-Hill, Inc., 1953, pp. 355-358.

tising expenditures upon the level and slope of the demand curve, the statistician would do better, in most cases, to study the effect of the accumulated advertising charge. Probably current advertising expenditures are not a good "demand shifter;" that is, they are not highly correlated with current changes in the level and slope of the demand curve. We would expect some weighted total of past and present advertising expenditures to be much more successful in most cases.

Second, in cases where the advertising budget is held almost constant over long periods of time, or in cases where it remains for several months or years at a constant percentage of gross income, the economist might do well to try a method proposed many years ago by Roy.[11] M. Roy is a Frenchman who studied mathematics and economics after he was totally blinded by gas in World War I. He made some very interesting statistical studies of the demand for such things as postage stamps and trolley fares. These were selected because the prices were held constant over long periods of time, perhaps changing only once in several years. Roy measured demand by studying trends in consumption both before and after each major price change. He found, for example, that when the price of postage stamps was lowered, the former trend was changed. However, the new trend was not definitely established for several years. In other words, the effect of a price change was spread over several years, just as the effect of advertising is probably spread over several periods of time.

This suggests the possibility of measuring shifts in demand resulting from changes in expenditures for advertising and promotion, even though such changes may be very infrequent. But, as indicated above, no method of analysis can ever give us useful measurements of the effectiveness of advertising and promotion unless there are significant changes in those expenditures, however infrequent they may be.

An entirely different aspect of demand is of great concern to farmers and urgently needs study by economists and statisticians. The researchers who study demand curves often speak of "cross elasticities," meaning the elasticity of consumption of some commodity with respect to the price of some other commodity. We need to know much more about how the advertising of one food affects the demand for a competing food.

Farmers as a group gain little or nothing from competitive advertising of food brands unless such advertising raises the total demand for food as a whole. In a similar way, neither the Maine farmer nor the Idaho farmer is likely to gain very much if each state advertises its own potatoes at the expense of the other state.

Such cross effects are much more difficult to measure than are the direct effects, simply because they are ordinarily smaller. Still, this is a very im-

[11] René Roy, *Études Économetriques,* Paris: Sirey, 1935.

portant aspect of promotion. It is an aspect that greatly concerns farmers. Aside from competition between brands, and between producing areas, there is naturally much competition between different foods. Successful promotion of turkeys may reduce the market for broilers. Before the farmer goes overboard for compulsory support of advertising, he wants some facts on these matters. So far, we have very few facts to give him.

The Returns Curve

Twenty years ago, Wellman[12] explained the principle that determines the most profitable allocation of selling efforts among geographical areas. In Wellman's words, "The essential question may be stated in either of two ways: (1) How should a fixed total expenditure for selling effort be allotted among geographical areas in order to maximize total sales? Or (2) what allocation of selling effort among geographical areas would minimize total expenditures for a given volume of sales?"

To answer those questions, Wellman showed that one must first estimate what he called the "sales curve" in each area; then he must so distribute the available promotional funds as to equalize marginal sales from promotion.

Wellman's sales curve shows the expected volume of sales in each area as a function of varying promotional expenditures in that area. I prefer to use here the concept of a "returns curve," showing the expected net value of increased sales due to promotion. I shall assume that the businessman wants to maximize the expected net value of increased sales obtained from the expenditure of a given sum of money. But the principle is exactly the same as that explained by Wellman 20 years ago. That is, the promotional funds must be so distributed as to equalize net marginal returns.

The principle is illustrated by Figure 3. The three heavy curves are intended to represent the expected increases in the net returns for some commodity in three areas. In each case, we assume decreasing returns from promotion. This is shown by the fact that the curves rise at decreasing rates as expenditures increase. Now suppose that the initial allocation of promotional funds is that shown by the circles. At these three points, the middle curve is flatter (less steep) than either of the others. The slopes of the curves measure marginal returns. In other words, the initial allocation of promotional funds, the marginal returns from market 2, are less than those from either market 1 or market 3. Suppose that a dollar of promotional funds were transferred from market 2 to market 1. The loss in net returns from market 2 would be more than offset by the gain from market 1. The same is true of a transfer of a dollar of promotional funds from

[12] H. R. Wellman, "The Distribution of Selling Effort Among Geographic Areas." *The Journal of Marketing*, January, 1939. Vol. III. No. 3.

market 2 to market 3. Such transfers of funds would always be profitable so long as the marginal returns from any pair of markets were unequal. Thus, the equalization of marginal net returns is a necessary condition for maximum net income.

We could shift funds and observe graphically the slopes of the several curves. In time, we would reach a situation where the slopes were all equal—that is, where tangents to the curves were parallel. In Figure 2, such a situation is shown by the squares, corresponding to expenditures $\bar{e}_1$, $\bar{e}_2$, $\bar{e}_3$, in markets 1, 2, and 3. Assuming that the three curves accurately measure the responses to advertising in three markets, and assuming a

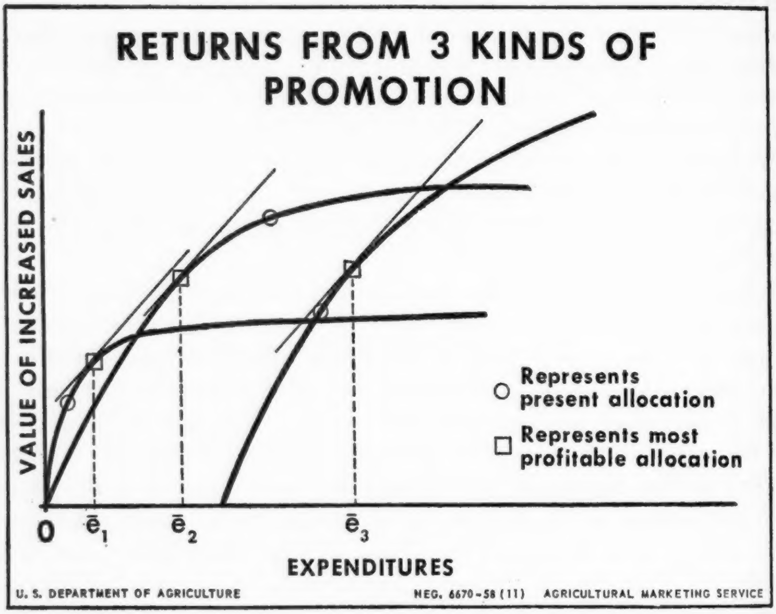

FIG. 3

promotional budget of ($\bar{e}_1$, + $\bar{e}_2$, + $\bar{e}_3$,) dollars, the most profitable allocation of that budget is $\bar{e}_1$, to market 1; $\bar{e}_2$, to market 2; and $\bar{e}_3$, to market 3.

No one can successfully dispute this principle. It is a geometric fact, like the Pythagorean theorem about right triangles. It is true—exactly, inescapably, eternally. The only question is how to estimate the returns curves. This must be done, in one way or another, if the problem of optimum allocation is to be solved.

As Wellman put it, "unless the functional relations are determined, it does not appear that the problem of distributing selling effort among geographical areas in such a way as either to maximize total sales or to minimize total expenditures is capable of being solved."

This, I believe, is true. I do not think that Cowan's[13] "Answer," in the source issue of the Journal, 20 years ago, threw any doubt upon the validity of the principle of equalizing marginal returns. Rather, it questioned the reliability of returns curves derived from market data by the use of correlation and regression techniques—preferring the less formal analysis, in which "management, in each area, weighs the effect of a little more or less of different kinds of effort. . . ." To me, at least, this is not a major issue. I suppose the informal judgment of management should be used to temper the cold statistical conclusions obtained by least squares. But who would deny that statistical correlation and regression have proven to be invaluable tools in analyzing matters of this kind. As I see it, the main point is that we must have reliable estimates of the returns curve. Then we must use the principle outlined by Wellman.

I suggest further that the techniques I have outlined in discussing the decay curve will prove useful as a part of regression analysis. What we should really want here is not the immediate returns curve for each market, but a curve showing the eventual net returns as a function of promotional expenditures. This means setting up an equation that allows for the effects of past advertising. It means a more refined model than some that have been used. But it is still regression analysis. And the researcher would still do well to check his results with practical, experienced market analysts.

Finally, the principle of equalizing marginal returns is not limited by any means to the allocation of promotional funds among geographical markets. The same identical principle applies to any kind of allocation of funds.

One important case is the allocation of advertising to newspapers, to magazines, to radio, to television, to billboards. Here we need to estimate net returns curves from each kind of advertising. Then, expenditures should be adjusted until marginal returns are the same from each advertising medium.

Different sales appeals, slogans, and pictures could be studied in the same way. Here the seller would have to try one appeal after another to give the statistician the necessary data.

The seasonal distribution of promotional efforts is another problem that could well be studied by analyzing marginal returns.

Chain stores and supermarkets must decide which commodities to advertise to maximize total returns from their whole business. Here they need curves showing how their net returns are affected by advertising expenditures on each of several commodities.

---

[13] D. R. G. Cowan, "In Answer to Professor Wellman," *The Journal of Marketing*, January, 1939.

These examples do not exhaust the possibilities of the general method Wellman presented 20 years ago. That method is the key to solving all problems of finding the most profitable allocation of funds for advertising and promotion.

The main problems of research in this field are, then: first, get accurate data on past expenditures for promotion; second, analyze these data in such a way as to give reliable estimates of the net returns curves in different segments of the whole market; and, third, adjust the allocation so that net returns are the same in all segments.

In principle, this method is similar to the iterative process being used in linear programming. In fact, the problem we are dealing with here is one of nonlinear programming. We start with a given "feasible" allocation test to discover profitable changes, and make any changes that will raise net returns. When there are no further profitable changes, we have the "optimum" allocation of funds.

Looking Ahead

Some of you may think I am too optimistic about measuring the economic effects of advertising. But I am not the only optimist in this field. Well-known business journals[14] have been recently reporting that large industrial corporations are setting up economic research units for this particular purpose. They apparently think such economic research will pay off—that it will help the corporation to get the greatest possible net returns from its advertising and promotion.

So far, agricultural economics has not concerned itself much with promotion and advertising. In my opinion, this is most unfortunate. Large sums are being spent to advertise food, clothing, and tobacco products. Even though the farmer does not pay directly for much of this, he certainly has an interest in it. He has a more direct interest when money from his wool payments is withheld to promote wool and lamb. And if and when the Congress should authorize "self-help" programs, the farmer will be demanding concrete, dollar-and-cents estimates of economic results. He will expect economists to come through with measurements that are reliable enough to be a useful guide. The psychologists have demonstrated their usefulness in this area. I have no doubt that economists will do so, too.

And I think some of the most useful economic research will be based upon the concepts of decay curves, demand curves, and returns curves.

---

[14] "Measuring Ad Effectiveness—What Research Can—and Can't—Do," *Printer's Ink*, September 26, 1958.
"A Profit Yardstick for Advertising," *Business Week*, November 22, 1958.

DISCUSSION: COMMODITY ADVERTISING OF FARM PRODUCTS

SHELBY A. ROBERT, JR.
American Dairy Association

It is a real pleasure to have the opportunity of appearing on this program this afternoon and discussing the papers presented by Hoos and Waugh. In many ways it is more difficult to prepare a discussion of papers like this than those with which one might take greater issue.

In my discussion this afternoon I would like to (1) comment briefly on the two papers and then (2) indicate some of the ways that the American Dairy Association approaches the problem of evaluation of its advertising. In so doing, I would like to present some brief results of a national study made in 1956 which indicates what farmers actually think about promotion and advertising activities.

Hoos and Waugh apparently arrive at the position that advertising of agricultural products is not only inevitable, but almost desirable. They then leave the consideration of whether advertising is or is not desirable for agriculture and approach the problem of evaluation of its effectiveness. This I would consider constructive appraisal. Agricultural economists can be of considerable benefit to the various industries by assisting us in appraisal of all kinds of selling methods. Thus, I am in agreement with most of the statements made in the two papers and we would appreciate assistance in developing means of approaching the kind of appraisals suggested in each paper. There are, however, other methods of appraisal.

There is one point where I must quarrel slightly with each of the papers. Advertising to the firm and advertising to the industry is in a little different category. For example, most fluid milk distributors are not concerned primarily with market expansion. They are concerned with share of market for their particular brand. On the other hand, a dairy industry program paid for by dairy farmers has as its specific objective total market expansion. There are instances where a dealer in a prominent position must adopt marketing objectives close to those of an industry approach because he has such a large share of the total distribution that he cannot expand his share without expanding the market.

There is another part of this question, however. Supposing that the oft quoted statement is true that the elasticity of the stomach is zero, I have yet to see anyone propose a realistic program for advertising food in general. The principle of substitution does work, does and therefore provides competition, does provide more efficient distribution and production and does fit into our way of life. An industry or product approach to advertising food or farm products provides the kind of competition that the consumer finds available in appraising the purchase of an automobile,

a television set or a suit of clothes. The farmer has just gotten into the business-end of marketing at a little later date.

In the summer of 1956, the American Dairy Association employed National Analysts, Inc. to work with us on a study of dairy farmers' attitudes towards promotion and selling activities. We selected a national probability sample of dairy farmers who sold 50 pounds of milk or more per day for the month preceding the interview. We used a carefully constructed questionnaire so as to cover the identity of the sponsoring organization until about one-half of the questioning was complete. In very general terms we found that dairy farmers think and act like businessmen. Their responses to the questions asked by interviewers in this study indicated clearly that most dairymen look upon their operations with a careful business attitude.

Dairymen believe they can improve their own business situation through constant efforts to increase their productive efficiency. Most of them, 87 per cent as a matter of fact, feel that sales promotion efforts hold forth great opportunities for market improvement, and 78 per cent of the dairymen assume personal responsibility for at least part of this sales promotion effort.

This study provides adequate indications that it is a correct assumption that farm people no longer believe their job is finished when the product leaves the farm. They recognize the necessity for being interested in marketing, including sales promotion efforts designed to expand the markets for their products.

The study indicates also that dairymen use information that comes to them and that they want more information. They are, for the most part, quite aware of the sales program of the American Dairy Association because they see it in action, but most dairymen, members as well as nonmembers, seek additional information about the organization and how it functions. Our conclusion from the results of this study was that sometimes our farm population is ahead of some of its leaders in thinking about means of answering marketing problems.

The dairy farmer is the only factor from the cow to the consumer who is solely concerned with milk and dairy products for his profit and income. This is true of other kinds of farm operations as well. Most farmers are pretty well specialized. This is the main reason why they feel they must assume certain responsibilities in selling and marketing past the farm gate.

There are so many difficulties associated with appraisal of advertising effectiveness by sales results only, that we have been attempting to work on alternative methods of appraisal. The sales analysis can have all kinds of other factors influencing the sales level. Further, in dairy products we have varying levels of butterfat content which influence per capita consumption. The consumer, for example, may be buying a lot more quarts

of milk, but on a butterfat or milk equivalent basis we may be reporting declines in per capita consumption. Another example is the shift in cheese consumption patterns that have taken place as a result of the shifting emphasis on cheese spreads and cheese foods. These products contain a lower portion of cheese, therefore a lower content of butterfat than does natural cheese.

We have been trying to specify market targets that we want to reach in our promotion activities, using advertising, merchandising and public relations tools to reach people representative of these targets. We set up specific objectives for the campaign that we want to get across to these targets. Then through various methods we try to measure the number of messages we get across within the objectives specified to these target groups. Through time we can see progress or a lack of progress in reaching consumers by this manner. Basically, we are trying to see whether we change consumer attitudes or whether we change them in accordance with the original objectives of our promotion activity. Although this is just a thumbnail sketch of these means, we can appraise the effectiveness of campaigns without being concerned about outside activities which may influence sales. We are, of course, assuming that sales and the right kind of attitude as determined by research results are closely correlated. We have a number of examples that indicate that this is true.

Another method we are using for evaluating our activities is a market test approach. It is hard to find an isolated situation in which to test new campaigns, but we try and we can measure some results. In these instances it is necessary to rely on sales results.

My conclusion cannot be much different from that of Hoos and Waugh. We feel that promotional activity on an industry basis is important and constructive to the farm economy. We feel that we can appraise, in general, significant changes in consumers' attitudes and activities that indicate measures of effectiveness. They are far from appraisal based on sales results. These do, however, answer questions which might be raised and are indicative of the appropriateness of an advertising program.

DISCUSSION: COMMODITY ADVERTISING OF FARM PRODUCTS

SEYMOUR BANKS
Leo Burnett Co., Inc., Chicago

Reflection upon the two extremely interesting papers presented by Hoos and Waugh leads me to believe that the fundamental question which both of them have addressed themselves to is: "What will advertising do for the demand for farm products, both in the short and long

runs?" I believe that this question cannot be answered on the basis of *a priori* assumptions. Instead, it must be resolved in the same way as any other technological problem is to be solved—by a process of experimentation and evaluation of results.

I think that the members of the American Farm Economic Association are people in a particularly appropriate position to make significant contributions to the measurement of advertising success or failure and I want to spend the bulk of my time talking about that. However, before I speak on that subject, I want to address myself to a few remarks on the general subject of the effect of advertising upon the demand for farm products. As you may remember, there was a great deal of discussion on the effect of advertising upon our economy during the 1930's. Neil H. Borden of the Harvard Graduate Business School was commissioned to make a study of this subject and produced a monumental work *The Economic Effects of Advertising*.[1] Borden studied a great many situations in which advertising had been used to affect both primary demand and selective demand. By "primary demand" is meant the demand for a product class as a whole, while "selective demand" refers to demand for individual brands or makes within the product class. On the basis of an examination of a great many products and product classes, Borden drew some basic conclusions:

> "When advertising has been used, its chief affect upon primary demand has been to speed up the expansion of demand that naturally would have come about without advertising, or to slow down an adverse trend. Consumer's wants for products have been determined by the character of the consumers and the resisting environment. Advertising has not changed people's basic characteristics nor has it appreciably affected their mental environment. It has merely played upon consumer's buying motives to intensify desire in order to build favorable attitudes toward product consumption. In helping usher in innovations and in speeding up demand for some products and slowing contracting demands for others, advertising has had an effect in altering consumer's living habits and attitudes and has thus had an effect upon environment. But it is believed that it would be an error to magnify its direct influence in guiding or shaping living habits."

Thus, American agriculture cannot assume that advertising can reverse long-term trends in declining per capita consumption of many products nor reverse the desire of the American housewife to buy convenience added to products that she buys, rather than buying more of the basic commodities themselves.

Advertising effects for broad products classes are likely to be small with an unknown distribution of effect through time. This situation undoubtedly raises as many questions for the practical problems of measurement of effect as in the establishment of realistic theory.

Let me turn to the main point of my comments. For a long time I have

---

[1] Neil H. Borden, *The Economic Effects of Advertising*, Homewood: Richard D. Irwin, 1947.

puzzled over why relatively little experimentation is carried on in the field of marketing research. In the end, I have come to the conclusion that the fundamental deterrent to the use of experimentation in marketing research is not the lack of experimental designs since they can be readily adapted from agricultural research; instead, the problem is one of collecting the data with sufficient ease and economy to make research possible.

There are two interrelated problems: (1) the determination of exactly what is the area of influence of locally originated advertising media; and (2) how properly to measure sales changes within these local market areas. The reason for the first point is that the test unit for these tests is not a store but a market subject to advertising or promotion. A great deal of work has been done on the trading areas of markets by Paul Converse at the University of Illinois, but considerable work needs to be done in terms of the geographical areas in which various media—newspapers, television, radio—have significant effect upon sales. It may very well be that different media will have entirely different patterns of geographical coverage.

The basic technique used in measuring the sales effect of advertising or any other promotional device in accepted practice is to use censuses. They are usually called audits or inventory counts, but essentially one finds the inventory of a product at the beginning of a research period, tabulates the invoices of shipments during the test period and, finally, subtracts the inventory on hand at the end. This technique has some practical problems. In the first place, not all stores are willing to permit this to be carried on with the thoroughness required; for example, the A&P has a corporate policy against such cooperation. In addition, it may be extremely tedious to accomplish. The alternative to complete auditing is, of course, sampling. By this, I mean collecting the basic data on sales of commodities by time clusters within sample stores.

What I am calling for is an extension of the research project which has been carried out for the last 10 years by Max E. Brunk and his co-workers in the agricultural economics department at Cornell University. Their work has been published in six papers under the general heading "Methods of Research in Marketing." One of the most interesting is Paper #6 by Murray A. MacGregor entitled "Uniformity Trial Experiments in Marketing Research." His purpose was to determine a means of studying the variability in the volume of commodity sales in supermarkets and then suggest how the results of this study might be applied in the development of experimental designs. He studied the daily unit sales of eggs, apples, carrots, potatoes, milk, bread, cinnamon, bacon, frozen orange juice, frozen peas and vegetable soup. His data indicate that the day-to-day variation in sales was larger than the store-to-store variation, and in turn, the store-to-store variation was larger than the week-to-week variation. For most commodities, the store $\times$ day interaction is the largest

interaction effect. There is evidence of a three-factor interaction for all commodities—store $\times$ week, $\times$ day; however, this appears to be appreciably higher for some commodities than for others. MacGregor's findings need to be extended both in terms of area, types of stores studied, seasons and finally commodities. Simultaneously, if possible, tests should be run to determine the economic efficiency of the standard audit system of measuring sales versus those of procedures for sampling individual purchases by consumers at check-outs through time clusters. The basic data which are utilized in determining variation of commodity sales within stores will obviously be of value for the latter purpose as well.

In short, I am inviting the members of the American Farm Economics Association and the American Marketing Association to join in fundamental research on the variability of sales within stores in order to develop fundamental techniques which can be used in evaluating advertising or other promotional activities. The techniques and procedures which might be developed for farm products obviously would benefit all advertising and marketing. The development of such tools and their intelligent use in the evaluation of all kinds of marketing, promotional and advertising effort should aid in evaluating and improving marketing procedures as much as experimentation has aided agricultural production. However, one word of caution: One cannot talk casually about advertising as if it were a simple commodity, believing a dollar of advertising is equivalent to another dollar of advertising very much as you can speak of a pound of fertilizer being equivalent to another pound of the same fertilizer. Instead, there are tremendous variations in effectiveness of various types of advertising or of campaigns. In addition, soils, animals, individual plants do not have minds of their own; they do not develop counter-strategies. In marketing, on the other hand, one is always faced with a dynamic situation of retaliation and counter-retaliation. It will be difficult enough to determine what happens when you do something. There will be many more problems arising when two competitors simultaneously try out different strategies in a market. Our experimentation must encompass such varied and shifting problems.

DISCUSSION: COMMODITY ADVERTISING OF FARM PRODUCTS

E. L. BAUM
Tennessee Valley Authority

The subject under discussion is both timely and difficult. I believe that there is general agreement that the paucity of quantitative studies measuring the effects of advertising and promotion on the market demand

for farm products does not permit us to speak too precisely about the merits of these activities.

Hoos presented an excellent review of the economic theory showing how advertising (selling costs) may be introduced into firm theory. His subject was broad, time was limited, and quantitative data are few, so it is understandable that he skimmed over many relevant topics. Hoos stressed the importance of knowledge of the effects of advertising in making management decisions concerning these types of expenditures. The theoretical considerations presented by Hoos are relevant and should be subjected to empirical tests if we are to make progress in this important field.

Waugh's paper was of interest in that he indicates more attention should be given to the concept of the decay curve in our evaluation of specific advertising campaigns. His comments on the effects of advertising on demand curves are of basic importance and well-developed. Our main problem is that of measuring the effects of specific advertising and promotional campaigns. After reviewing both papers, it is evident that our problem remains unsolved.

Waugh does not give adequate attention to the role of psychological, sociological, and related research in securing a better understanding of the consumer's preference structure. If advertising attempts to alter the consumers' preference system, which the economist takes as given, then more attention should be devoted to knowing the make-up of the preference system for consumer units (households) possessing different measurable attributes. The economist might profit by working more closely with researchers trained in psychology and sociology when he attempts to determine consumer motivation to specific advertising programs. This team approach should enable the economist to do a more realistic job in developing relevant conceptual models and techniques that would result in better measurements of specific advertising campaigns.

It is doubtful that American agriculture can advertise and promote itself out of its present and near future surplus conditions. In general, the price and income elasticity of demand for farm products is relatively low—and many of these commodities are considered to be basic everyday needs. In addition, many farm products have a relatively high cross-elasticity of demand. For example, the American Meat Institute could spend considerable funds advertising the virtues of red meat in attractive, appealing advertisements. However, if broiler meat happens to be in plentiful supply and the price of this meat is much more attractive than red meat, consumers will shift toward the cheaper meat item. There are numerous examples among food products. I contend that relative price relationships are more important than advertising in influencing the con-

sumer's consumption patterns in the short run. Also, we should remember that the capacity of the stomach is limited.

If major agricultural industries are to have "self-help" programs with farmer check-offs for research, advertising, and promotion, probably the resources could be used to better advantage by spending the funds for research in the development of new ways to utilize these basic commodities. For example, cotton farmers may create a bigger market for cotton if they sponsor research that would make cotton more competitive with nylon, rayon, and other new "miracle" fabrics, rather than spending the bulk of their funds extolling the virtues of cotton.

Waugh feels that through research, we should be able to predict the effects of a particular advertising campaign, just like our present ability for the agronomist to predict crop response to fertilizer inputs. I believe that we are not dealing with parallel situations. The agronomist has control over the level of soil fertility, crop variety, cropping practices, and the like. Under these conditions, he can observe response under varying climatic conditions and make his prediction at specified probability levels. The economist and his associates are not in a similar position to identify all the important variables, let alone to quantify their influences. There are too many variables that cannot be controlled in this type of economic experimentation. Much can be said here, but time is limited.

The "decay curve" concept illustrated for radio-active carbon-14 mentioned by Waugh as a method for measuring the effects of advertising campaigns on the demand for farm products is of academic interest. Perhaps the results of Waugh and Nerlove's application of the "decay curve" might give us a better basis for determining its usefulness. As of now, I see very little practical use of this concept unless the economist can control or better explain the effects of all the important economic and noneconomic variables affecting demand. Without many qualifications, I find it difficult to accept the hypothesis that there may be a lagged effect of specific advertising campaigns on the demand for farm products—most of which are basic commodities used almost daily. The nature of demand changes very slowly over time, as do our other customs and habits.

The effects of various levels of advertising expenditures in helping management to make advertising decisions appear to be relatively successful for specific branded food products. However, the problems of measurement become complex when the economist tries to evaluate the economic effects of industry-wide advertising, e.g., milk advertising by the American Dairy Association (ADA). In order to gain an insight into the effects of industry-wide advertising, one can conduct such studies in selected markets observing the influence of advertising on samples of families selected through the use of sound and proven area sampling

techniques. I conducted such a study several years ago under a grant from the ADA. The results of this study and the techniques of measurement used were reviewed thoroughly by many competent economists and statisticians, including Hoos. I was fortunate in having the close working relationships with colleagues in psychology and sociology throughout the conduct of the study. The results were not particularly gratifying to the sponsors of the study. My experience leads me to disagree with Waugh's statement that "short period" studies of specific advertising programs are of little value. The consumer is bombarded with so much "influencing media" that the conscious mind retains very little, unless he or she is looking for a particular item. Through these relatively short-run studies, economists can secure a better idea of the consumer preference system for specific foods and closely competing products.

Briefly, in the study referred to above, we attempted to measure the effects of a three-month dairy advertising program in the spring of 1951. We selected samples of families (in consultation with personnel at the Iowa State Statistical Laboratory) in Seattle, Yakima, and Spokane, Washington. Data on family make-up, education, income, dairy product consumption, attitudes toward various dairy products, and general attitude toward advertising were secured at least a month prior to the three-month campaign. The analysis of the "before" survey indicated no statistically significant differences among the three cities. A month after the campaign was over, we resurveyed the same families. In addition to determining whether any changes in dairy product consumption occurred, we also asked specific questions about the magazine, newspaper, and TV ads. These advertisements were supplied by the ADA. We found that the ads were recognized by an insignificant number of respondents who indicated little or no motivation upon recognition. These results were similar in all three cities. In addition, we selected samples of "control" families in all three cities to determine whether the "after" results indicated by our study of the "test" families were different. The study of the "control" families indicated similar results as those found with the "test" families. Incidentally, per capita consumption of milk, cottage cheese, and ice cream for the test families did not change during this six-month period. Some consideration was given to resurveying the test families six to 12 months afterwards, but it was decided to terminate the study because of the insignificant recognition and motivation from the advertisements indicated by the "test" and "control" families. The results of this particular study do not negate the wisdom of brand advertising and promotion by individual firms. The respondents did indicate some motivation to these efforts. I realize that due to time limitations, I glossed over this particular study hurriedly.

I participated in a promotional and advertising study of egg sales in a large chain in Washington. We used a biometric design to determine effect of price and display on sales. We also studied egg sales in nearby stores, and consumers who purchased the "test" eggs were interviewed in their homes. When the price of eggs was lowered appreciably compared to the general retail market price, we found that egg sales increased appreciably. There were more purchasers and more was purchased per buyer. However, sales in nearby competing stores decreased until they met the price competition. Instead of buying eggs for three- or four-day needs, the consumers purchased for six- or seven-day needs while the price was "right." Did we actually increase the total demand for eggs by fluctuating the price and promotional variables?

There are some workable techniques of measuring advertising and promotional activities, but these studies are difficult and costly to conduct. In this connection, I should like to mention the long-time family consumer panel conducted by Michigan State University. Specific advertising and promotional programs could be measured through such a panel of families. In closing, I should like to indicate that we have many analytical techniques available that would give us a better insight into the effects of advertising and promotional activities on the demand for farm products. I believe that our biggest problem is that of experimental control, manpower, and funds to conduct meaningful studies.

DISCUSSION: COMMODITY ADVERTISING OF FARM PRODUCTS

LESTER G. TELSER
University of Chicago

Waugh's very interesting paper highlights some major facets of the advertising problem. His decay function based on the work of Nerlove formalizes the familiar idea that it takes time for the full effects of an advertising campaign to be realized. That part of his analysis is easily carried one step further to estimate the present value of a given advertising expenditure which brings in one dollar initially, $1 - x$ dollars in the next period, $(1 - x)^2$ dollars in the next period, etc. Using his decay function, which by the way is a simple geometric progression, the present value equals

$$P = \frac{1 + r}{x + r}$$

where r is the firm's rate of return on capital. The advertising appropria-

tion is profitable so long as the present value of the receipts stream exceeds the advertising appropriation.

I found the theoretical discussion by Hoos comprehensive and informative. Although I am sympathetic to his position as a whole, I was sorry to see that he chose to leave aside the interesting problems raised in considering how advertising might help or hinder the solution to the farm problem. I think there are certain things that need to be said on that score and hope you will bear with me as I turn to these.

Most farm products are already advertised, though not directly as farm products. Canned and frozen fruits and vegetables, cereal products, dairy products, cotton products, e.g., Hathaway shirts, tobacco products (rather successfully) and many, many others. Thus the question we should try to answer is not whether to advertise farm products but rather whether to advertise farm products *more* and how to advertise them more effectively.

Now suppose we had estimates of the present value of additional expenditures on advertising farm products at the going rate of return, 10 per cent, which is not far from the mark, and it turned out that the present value exceeded the cost. That would imply that somehow the people engaged in selling goods embodying farm products are not doing their job because they have overlooked profitable kinds of investment, namely advertising of their goods. Now I do not care to argue that these businessmen do not make mistakes so that they may be passing up profitable opportunities, but we should recognize that any argument which assumes that there should be more advertising of farm products rests, at least tacitly, on this presumption.

Those businessmen already advertising their products which embody stuff made on the farm are, of course, interested not only in increasing the demand for, say, shirts as a whole but are also interested in increasing the demand for their brand of shirts. Would anyone care to argue that advertising a generic product class is more effective or less effective than advertising a brand in the product class? In view of the competitive nature of the business of processing and selling farm products, I would lean to the view that advertising is better carried out as it is than by government fiat.

Obviously, I have skipped over some other important issues. The farmers' spokesmen are not really interested in advertising farm products per se. What they really want to accomplish by advertising is to increase farmers' incomes. Now let us be realistic. What are the farm products in the greatest trouble? . . . cotton, corn, and wheat. Technological advances have made our storage facilities groan under the weight of the first two especially, and a diet conscious America has caused most of the trouble

for the wheat producers. What can advertising accomplish for these three commodities?

I can see some prospects albeit indirectly for corn via the advertising of meat. Currently most meat products are not advertised. When we buy a T-bone steak we do not know whether Wilson, Swift or Armour are in our debt. The meat packers do not find much to gain from advertising for a number of reasons. One is that the government grades meat. Could Swift convince an American housewife that a prime T-bone is better if it carries their label rather than Armour's? Perhaps so, but I rather suspect that were government grading of meat abolished, Swift and the other meat packers would more willingly advertise all of their products. Parenthetically, I certainly am unwilling to abandon government grading of meat, though my confidence in the competitive workings of a free economy is great. Besides, suppose the meat packers did advertise their meat products and thereby they increased the demand for meat. Would that help farmers producing livestock? Let us be clear on the matter and be sure that we focus our attention on the relevant issues. If Swift and the others do not advertise their meat products, they have good reason for their decision. There is no presumption that the social and private interest diverge on the matter.

I can think of some farm products that could be successfully advertised and furthermore their producers would greatly benefit from such a campaign. Artichokes come first to my mind. They are grown primarily on the Monterey Peninsula in California because a favorable climate (cool, damp, ocean air) combines with the proper soil to make this possible. Elsewhere we find artichokes grown only in certain parts of coastal Spain and Italy. Artichokes have a delicate and distinctive taste that appeals to sophisticated people with refined taste buds. In fact many people do not even like artichokes and that is all to the good. What an opportunity for snob appeal! Moreover, artichokes require great skill in eating them properly and only fine cooks can prepare the right kind of sauce that will do the artichoke justice. A marvelous selling point for do-it-yourself America! Any increase in the demand for artichokes, and by the way they do not require any processing by manufacturers, would redound almost entirely to the benefit of the artichoke producers. Their final advantage, and here I blush because I feel I am gilding the lily or rather the artichoke, is that there are relatively few artichoke producers, they are a hard working, deserving lot, and it would be rather easy to form them into a cartel so that they could even enjoy the greater profits of the monopolist. Perhaps my friends from California could look into the matter.

THE SIGNIFICANCE OF INDUSTRIAL ORGANIZATION AND MARKET STRUCTURE TO DEVELOPMENT AND MARKETING PROBLEMS

Chairman: Robert L. Clodius, University of Wisconsin

CHANGING STRUCTURE OF THE AMERICAN ECONOMY: ITS IMPLICATIONS FOR PERFORMANCE OF INDUSTRIAL MARKETS

JESSE W. MARKHAM
Princeton University

Industrial Structure and Market Behavior: The Theory

THE implied assumption underlying most inquiries into the public policy significance of the structure of industry can be expressed syllogistically as follows:

Major premise: market structure in some more or less predictable fashion affects market behavior.

Minor premise: the structure of American industry has undergone, and is undergoing, significant change.

Conclusion: the present and the predicted future behavior of industrial markets differs from that of an earlier era.

The validity of the major premise rests almost entirely upon an *a priori* logic set forth by Chamberlin over a quarter-century ago: somewhere along the spectrum of firm numbers, moving from the "infinite number" of pure competition to the single-firm monopoly, lies a point at which market behavior undergoes complete change. This change manifests itself in a self-imposed limitation on the means open to firms in the pursuit of (maximum) profits. Short of this point—still moving in the direction away from many firms toward the few—individual firms make no distinction between the initial and final effects of contemplated price changes. Consequently, they change prices whenever under present circumstances expected profits are higher at a price different from the current price. The present circumstances, for purposes of estimating the marginal profitability of a contemplated price change, can be considered permanent, at least insofar as they are affected by the price change itself. Beyond this point, where the market occupancy of each firm is large, all firms must distinguish between initial and final effects and take both into consideration. But price changes which may be profitable when rivals either do not detect them or let them pass unnoticed may be unprofitable when rivals are forced to retaliate. Hence, it is reasoned, price competition is less vigorous among the very few than among the very many.

This line of reasoning from market structure on the one hand to market performance on the other has not been seriously challenged,[1] however much the frequent use of such descriptive terms as "performance," "behaviorist," and "structuralist" schools of thought may suggest the contrary.[2] But most of those who concern themselves with the public policy issues raised by the structure of industry would probably agree with Professor Stigler that no oligopolist, simply by "colluding with his nasty little computing machine," can bring about the same market behavior as old-fashioned hands-across-the-table conspiracy.[3] The popular model of oligopoly rests on the assumption that each firm can detect and quickly counteract a rival's initial move, and is therefore especially relevant to price behavior. A price decision requires no gestation period, at least for those who follow, and to accomplish its purpose requires quick and efficient communication to the public. Oligopolists, aware of this, may logically reason that attempts to gain a competitive advantage over rivals by offering the product at more attractive prices are doomed to instant failure. Of all the possible business strategies open to the firm, price strategy is the easiest to detect, to counteract, and hence to defeat.

It is frequently inferred from this particular facet of oligopoly theory that oligopolists compete less than firms in industries of large numbers. But the logic of the oligopolistic model argues only that the firm will refrain from initiating actions which in the immediate future can be expected to make it no better off, and possibly worse off, because of the counter moves they prompt rivals to make. Rational oligopolists intent on maximizing profits will therefore channel their competitive effort where it is least vulnerable to defeat by such counter moves, or where the time period rivals require to defeat it is sufficiently long to make the effort profitable. The new product, the old product in a new package, the revitalized advertising campaign, a larger research budget, or perhaps even a choice merger or two, are obviously less easily counteracted than the simple price reduction.

To return now to the major premise, it can be assumed with reasonable certainty that structure is an important determinant of market performance. But the important inference to be drawn from the theories of oligopoly and monopolistic competition is not that the typical firm confronting an indeterminate or downward sloping demand schedule competes less, or more, than it would under conditions of pure competition,

[1] But see Clare E. Griffin, "Report on Antitrust Policy—Discussion," *American Economic Review*, May 1956 Supplement, p. 503.

[2] For a recent comprehensive appraisal of these schools of thought see Stephen Sosnick, "A Critique of Concepts of Workable Competition," *Quarterly Journal of Economics*, August, 1958, pp. 380-423.

[3] George Stigler, "Report on Antitrust Policy—Discussion," *Op. cit.*, p. 506.

but that it competes differently.[4] Understandably, those who equate competition with the aggressive use of price incentives reason that oligopolists compete less, while those who—following the late Schumpeter—equate it with the aggressive pursuit of innovational profits reason that they compete more, or at least compete in ways socially more desirable.

The problem is therefore in large part definitional, and will be resolved only after a more generally acceptable definition of competition has been devised. To equate competition with either so-called price competition or innovational effort is uselessly restrictive. It is also fallacious. A collusive agreement among members of an industry not to improve their product is surely a restriction on competition, even though price may not be immediately affected. And there are no logical grounds for supposing that oligopolists restrained from offering price incentives will necessarily, or even probably, turn their efforts to "Better Things for Better Living" to the exclusion of other competitive strategies. If the product is to be admitted as a variable for the firm then it, as in the case of price, can move in either direction.[5] Moreover, a lag in sales may very well argue for an increase in the advertising budget, even if this requires a reduction in outlays on research.

Since it can reasonably be generalized that industrial structure influences the form competitive effort takes, it is relevant to inquire into the specific structural characteristics which are likely to yield particular patterns of market behavior. The present state of theory and factual knowledge places severe limitations on such an inquiry. Except for the rather thorough analysis of the dominant firm case, theory has leaned almost entirely on models of evenly matched oligopolists. That is, the theory of oligopoly has not yet been extended to oligopoly's internal structure. Empirical investigations of market structure have developed a wide variety of indexes on firm numbers and size distributions, but have developed no stochastic relationships between them and patterns of market behavior. Such indexes, used in combination with the general theory of oligopoly, may within broad limits indicate those areas where price competition will be used relatively less and other means of competition relatively more; they do not indicate what the other means of competition are or the likelihood that they will be used. It is generally believed that these are determined by a host of factors, the most important of which

[4] This, I believe, is the inference Chamberlin himself draws: "More and more is price competition evaded by turning the buyer's attention toward a trade-mark, or by competing on the basis of quality or service. . . . The fact of such competition should at least be brought into the open by including the product as a variable in the problem." *The Theory of Monopolistic Competition,* 5th ed., Cambridge: Harvard University Press, 1947, p. 73.

[5] *Ibid.* p. 73 at *n.* 2.

may not be the industry's structural characteristics but such environmental factors as the technological horizon and the state of consumer knowledge.

Technological change affords a means for obtaining a competitive advantage rivals cannot quickly counteract. Patentable innovations receive 17 years protection, and those which are unpatentable may require considerable time to duplicate. Cost reducing processes which do not alter the product may be kept as guarded company secrets for years; and innovations which alter the product can be counteracted only after rivals have made the correct diagnosis and worked out the required alterations in their capital equipment. The extent to which innovational activity is used as a means of competition is likely to vary directly with the technological horizon envisaged, and this in turn is generally believed to vary inversely with the age of the industry. Recent innovations in such ancient industrial processes as cotton textile manufactures may call into serious question any generalization along these lines, but one is tempted intuitively to predict that the horizon is higher for the field of interplanetary rocketry than for, say, basket weaving.

If the state of consumer knowledge is highly imperfect, the firm may find altering, or exploiting, the bases for consumer preferences a more profitable competitive strategy than either price cutting or technological research. This does not imply that advertising, the usual means for altering the state of consumer knowledge, is socially less desirable than other means of competition. Advertising which improves the state of buyer knowledge makes for more rational choice, and therefore tends to reallocate resources more in accordance with demand patterns involving lower social costs of ignorance. Advertising which claims for commodities merits they do not possess, when buyers act on such claims, has the opposite effect. But whether advertising is socially "good" or "bad," the $10 billion annual advertising expenditure is persuasive evidence that sellers consider the state of buyer knowledge imperfect, and this in turn provides the basis for an alternative competitive strategy to price policy and innovational activity. There are also good reasons for supposing that competitive advantages obtained through advertising are counteracted less easily than those obtained through price reductions, and conceivably may endure even longer than the legal period of patent protection.

Industrial structure is probably an important determinant of how such competitive strategies as these are used, but this is a much too general and not an especially fruitful hypothesis. Neither the inductive nor deductive method has yet linked a specific market performance pattern with a specific set of structural indexes. Fellner observed in his *Competition Among the Few*[6] that although oligopolistic firms typically live in a state

of quasi-agreement, the agreement is usually confined to prices and almost never covers that vast range of market variables that come under the broad heading of inventiveness. Inventiveness is by definition the trying of the as yet untried, and is therefore unpredictable.

It would seem to follow, therefore, that the safest generalization on oligopoly is that the state of quasi-agreement leads oligopolists to compete on a price basis relatively less, and in terms of other market variables relatively more, than firms in competitively structured industries. How particular oligopolists will be disposed to allocate their competitive effort among these variables cannot be predicted from the theory of oligopoly and the conventional structural parameters. Hence, we are led back to the highly unsatisfying conclusion that the market performance of oligopoly is decidedly less predictable than that of competitively structured industries. For a society that places a high premium on the predictability of the course of economic events, this alone may be sufficient grounds for preferring competitive industry to oligopoly.

Industrial Structure and Market Performance: The Facts

In spite of the margins for substantial error in calculating indexes of industrial concentration, much more is known about the structural facts than about their implications for market performance. True, a wide gulf separates those who focus attention on the sociology of business and the historical evolution of corporate organization, and those who concentrate on quantitative measurement. Berle, probably the most articulate spokesman for the former group, observed in 1932 with Gardiner C. Means that large corporate enterprise had already destroyed the unity of ownership and control of property, and predicted that by 1970 it would have taken over the economy.[7] By the time his *20th Century Capitalist Revolution* appeared in 1954 the predicted corporate economy had arrived, 16 years ahead of schedule.[8] Meanwhile, however, the basis for corporate dominance had itself undergone revolution. In 1932 Berle equated corporate power with concentration in asset control and the wide diffusion of corporate ownership interests; in 1954 the basis for control shifted to the power and influence which transcended the simple statistics of large corporate enterprise. According to Berle, corporate organization at the mid-twentieth century was at once the instrument which had rendered

---

[6] William J. Fellner, *Competition Among the Few*, New York: Alfred A. Knopf, 1949, p. 182.

[7] A. A. Berle and Gardiner C. Means, *The Modern Corporation and Private Property*, New York: Macmillan Co., 1932.

[8] A. A. Berle, *The 20th Century Capitalist Revolution*, New York: Harcourt, Brace, 1954.

obsolete all economic theory, had given the United States a planned economy without government planning, and had even fashioned a private system of international diplomacy. Berle clearly believes that the American economy has undergone dramatic structural change, with profound effects on market behavior. Many would no doubt concur in Berle's thesis of substantial change, but some would render a less severe diagnosis.

If the industrial sector of the economy has in fact undergone such a revolution, the evidence must be sought in what Morris Adelman has called the physiology, as distinct from the anatomy, of the American industrial economy.[9] Industry's most striking feature is the long-run stability of those indexes designed to measure its over-all structure. Adelman's study of concentration showed that the share of assets owned by the largest nonfinancial corporations was no greater, and was probably smaller, in 1947 thn in 1900.[10] Nutter's study showed that the share of total value added in manufacturing by industries having a concentration index of 50 per cent and over stood at 32.9 per cent in 1900, and at 24.0 per cent in 1947.[11] The 1949 Department of Commerce report on industrial concentration showed that the weighted average concentration index for 129 industries was 44.0 per cent in 1935 and 41.0 per cent (using variable weights) and 46.0 per cent (using constant 1939 weights) in 1947.[12] Whatever tendency there may have been for concentration to increase in particular industries during this period was just about offset by a decrease in the relative importance of the more highly concentrated industries. Stigler, in his analysis of 20 significant industries having firms with assets in excess of $300 million in 1937, concluded that between 1904 and 1937 concentration had declined substantially in 14 industries, declined imperceptibly in three, increased slightly in one, and increased substantially in two.[13] The 1954 Federal Trade Commission's report on concentration showed that the 200 largest manufacturing corporations accounted for 37.7 per cent of the total value of industrial shipments in 1935, and for 41.2 per cent in 1950.[14] The Bureau of the Census study covering a more recent period showed that between 1947 and 1954 concentration increased in 180 of the 375 industries covered, decreased in 173, and remained un-

[9] Morris A. Adelman, "The Measurement of Industrial Concentration," *Review of Economics and Statistics*, November, 1951, p. 269.

[10] *Ibid.*, pp. 295-96.

[11] G. Warren Nutter, *The Extent of Enterprise Monopoly in the United States*, Chicago: University of Chicago Press, 1952.

[12] United States Department of Commerce, *Concentration of Industry Report*, 1949.

[13] George J. Stigler, *Five Lectures on Economic Problems*, London: Longmans, 1949, p. 62.

[14] Federal Trade Commission, *Report on Changes in Concentration in Manufacturing, 1935 to 1947 and 1950*, Washington, 1954.

changed in 22.[15] Over the same period the share of total value added in manufacturing accounted for by the largest 200 manufacturing firms rose from 30 per cent to 37 per cent.

Indexes which measure other aspects of the over-all structure of the industrial economy, but which are less indicative of changes in industrial concentration, also fail to reveal any perceptible long-run trend. Adelman's index of vertical integration—the ratio of value added to the value of total sales—stood at 32.6 in 1929, and at 31.4 in 1951.[16] In 1929 there were 24.9 business firms for every 1000 persons; in 1957 there were 25.0.[17] In 1900 there were 15.4 business firms with credit ratings for every 1000 persons; in 1943 there were 15.1.[18] In 1939 firms employing less than 500 employees accounted for 59.30 per cent of the total labor force; in 1948 they accounted for 60.54 per cent.[19] And corporations originated 58 per cent of all business income in 1929 and 1930, 58 per cent in 1946, and 54 per cent in 1950.[20] In the intervening years, calculated for every fifth year after 1930, their share varied between the narrow limits of 61 per cent and 56 per cent.

All of the foregoing studies make appropriate *caveats* concerning methodology and basic data. The list of qualifications is much too familiar to be repeated, but needs to be increased by at least one. Concentration measures are not especially revealing unless they are accompanied by corresponding indexes of firm turnover. Market power, to the extent that it can be inferred from such indexes, is surely as much a function of time as of market or asset share. A high and stable concentration index over a long period of time may signify much or little market power depending on the rate of turnover within and among the top group. Such data have not yet been systematically analyzed, but those appearing in A. D. H. Kaplan's study of *Big Enterprise in a Competitive System* showed that the turnover among the top 200 corporations over a 40-year period was fairly high, but that the turnover of the largest firms in each industry group was typically very low;[21] and a recent study by Seymour

[15] United States Department of Commerce, Bureau of the Census, *The Proportion of the Shipments (or Employees) of Each Group of Products Accounted for by the Largest Companies as Reported in the 1954 Census of Manufactures*, prepared at the request of the Subcommittee on Antitrust and Monopoly of the Senate Judiciary Committee, July 1957.

[16] Morris A. Adelman, "Concept and Measurement of Vertical Integration," in *Business Concentration and Price Policy*, Princeton: Princeton University Press, 1955, pp. 283-322.

[17] United States Department of Commerce business population series.

[18] Dunn and Bradstreet estimates.

[19] A. D. H. Kaplan, *Big Enterprise in a Competitive System*, Washington: Brookings Institution, 1954, p. 69.

[20] United States Department of Commerce, *National Income*, 1954 Edition.

[21] *Op. Cit.*

Friedland showed that the rate of turnover of the largest 50 industrial firms, irrespective of industry, declined between 1906 and 1950.[22]

While such quantitative studies have developed indexes which may be subject to large estimating errors and to interpretations not entirely free of ambiguity, collectively they point to the rather unexciting conclusion that nothing spectacular has happened to the over-all structure of the American industrial economy since the close of the great combination wave in 1904. Since 1947 the general level of concentration appears to have increased slightly, and turnover at the top may be slowing down. But over the past 50 years the number of firms has kept pace with the population, large corporations have grown in size in rough proportion to growth in the national income, and the largest firms have generally tended to grow at a rate comparable to that of the industries in which they are classified. To reach a different conclusion would require a demonstration that the available indexes on industrial structure are all systematically biased in a horizontal direction. There is little prospect that this hypothesis shall ever be tested or that, if tested, the conclusion existing indexes support would be significantly altered.

To recapitulate, if the market performance of industries generally cannot be predicted solely from their market parameters, and if the parameters themselves have undergone no perceptible long-run change, one of three possible conclusions follows:

(1) The performance of industrial markets has changed, and because of significant changes in industrial structure, but no study has yet identified and measured the structural characteristics which account for the change in market performance.

(2) The performance of industrial markets generally can be presumed to have undergone no perceptible change; or

(3) The explanation for whatever changes in market performance as may have occurred lies in the nonstructural—and probably the unmeasurable—developments in American industrial enterprise.

While the three conclusions may appear to be equally plausible, the rest of this paper is concerned primarily with the third possibility.

Nonstructural Determinants of Market Performance

Although the over-all structure of the industrial economy apparently has remained unchanged, economists concerned with industrial organization nevertheless appear to have reached a consensus that markets perform differently from the way they once did. Three discernible long-run

[22] Seymour Friedland, "Turnover and Growth of the Largest Industrial Firms, 1906-1950," *Review of Economics and Statistics*, February, 1957, pp. 79-83.

developments can be offered in support of this view. First, if market performance has not undergone perceptible change over the past half-century most American economic institutions designed to alter the course of enterprise must be written off as ineffective surplusage. The origins of most of today's large corporations antedate the federal corporate income tax, the antitrust laws, the Federal Reserve system, full employment policies, the periodic congressional investigation of industry, the exercise of moral suasion by government, and the present corpus of law governing labor relations, resale price maintenance, agricultural and strategic materials prices, and social security. If we define competition broadly as the actions firms take in order to obtain advantages over their rivals, it is clear that over the past half-century society has placed significant limitations on the means of competition, and in return has provided a more stable economic environment in which the remaining competitive weapons may be used.

These permanent limitations on private entrepreneurial decision making, and such less enduring controls as NRA, OPA, and OPS, have constituted a subtle extension of the public utility concept. The mid-twentieth century version of public control differs in form but in substance is akin to the tradition of *Munn. v. Illinois.* The legally constituted public commission and the public authority exercised directly by the President, Congress, and the press may restrain private decision-making differently, but both clearly restrain and it is not at all certain which restrains the most.

Second, in the 20th century, government and industry have grown at a tremendous pace relative to agriculture. In 1900 agriculture accounted for 37.5 per cent of the total civilian labor force and originated 21 per cent of the national income, and government payments amounted to only 6 per cent of the national income. In 1957 agriculture accounted for only 8.3 per cent of the labor force and 4.4 per cent of the national income, and government expenditures on goods and services had risen to 24 per cent of the national income.[23] These interesector shifts have no doubt altered the performance of markets generally. Agricultural markets conform closely to the model of pure competition, while industrial markets typically conform to the models of monopolistic competition or oligopoly. Hence, even if industrial markets were about as competitive in 1957 as they were in 1900, over the years a large amount of pure competition has been replaced by a less pure variety throughout the economy. Moreover,

[23] Data for 1900 from Robert F. Martin, *National Income in the United States, 1799-1938*, New York: National Industrial Conference Board, 1939; data for 1957 from United States Department of Commerce, *Survey of Current Business*, January, 1958.

much of the one-fourth to one-fifth of the total output of goods and services going to government is not subject to the market forces of supply and demand but to negotiations within a framework of complex technical specifications.

Third, much of the national output is produced by corporations much larger in absolute size than their 1900 counterparts. United States Steel, the first $1 billion corporation, was put together in 1901, and one-third of its assets reportedly was "water." The 1955 *Fortune Directory* listed 19 corporations having over $1 billion in assets and 27 corporations having over $0.67 billion in assets, the reported sound asset value of United States Steel in 1901. Large firms, according to contemporary organizational theory, would be expected to behave differently from small firms, even when both possess the same amount of market power. The entrepreneurial function, shared by departments and committees, is composite rather than individual.

The most apparent changes in American industry have therefore occurred in the business environment, and these have probably altered the ways industrial markets operate. The modern industrial corporation in possession of 15 per cent to 20 per cent of its market must choose carefully the methods by which it grows. It has long since been denied by law the methods once used by Standard Oil and American Tobacco; it has more recently been denied the gentler methods of Alcoa, A&P[24] and Bethlehem-Youngstown. Conglomerateness has therefore tended to replace outright monopoly power. Its price increases in times of general inflation undergo the close scrutiny of congress, a possible slap on the wrist by the President, and almost certain unfavorable review by the press and Walter Reuther. Its price decreases invite the charges of "unfair competition" and price "chiselling" respectively from its smaller and larger rivals. And substantial increases in profits beyond some "fair" rate of return can be expected to lead to heavier wage demands at the next collective bargaining session and possibly an invitation to appear in Washington at the next session of Congress.

Meanwhile, radio, television, the corporate research laboratory, and developments in packaging have provided large firms a new and different competitive arena; and the rise in family incomes has resulted in relatively greater expenditures on consumer durables, the sales of which are affected by price expectations, and relatively smaller expenditures on essential nondurables for which the concept of elasticity of price expectations is almost irrelevant. In this setting the large corporation not surprisingly finds in the new product, the slightly altered product, the old

[24] *Cf.* A. D. H. Kaplan, Joel Dirlam, and Robert F. Lanzillotti, *Pricing in Big Business: A Case Approach*, Washington: The Brookings Institution, 1958.

product packaged differently, the drive toward "automation," and the television show with a higher Trendex rating a more peaceful, and certainly less hazardous means of competition than the more violent and discriminatory price-cutting, cost-cutting, and throat-cutting tactics of an earlier era.

However, it would be doing serious injustice to the facts to cast contemporary corporate enterprise in the image of a commercial bureaucracy enjoying a peaceful life of administered prices, intent on harmonious coexistence with government and press, and concerned primarily with annual research and advertising budgets. There is no persuasive evidence that industrial prices, as distinct from the index of industrial prices, have become less flexible. Total advertising outlays, when expressed as a percentage of the national income in current dollars, have remained surprisingly constant since the end of the 19th century. Total advertising expenditures in 1900 amounted to $0.5 billion, in 1920 to $2.9 billion, in 1930 to $2.6 billion, and in 1957 to $10.2 billion. In 1900 total advertising expenditures amounted to 3.1 per cent of the national income, in 1920 to 4.2 per cent, in 1930 to 3.3 per cent, and in 1957 to 2.8 per cent.[25] Similar data for research outlays are not available. However, it is fairly certain that the organized corporate research laboratory has made serious inroads on the garret inventor. In 1900, 85 per cent of all the patents registered at the United States Patent office were assigned to individuals and only 15 per cent to business firms; in 1955 the percentages were exactly reversed.[26]

If significant changes have occurred in market behavior, they apparently do not spring from any measurable alteration in the structure of American industry but from changes in the institutional environment in which market forces operate. Cast in these terms, modern market performance holds out an important challenge to economic theory and public policy. Berle, as noted earlier, has looked upon the modern industrial market and concluded that all economic theory is now obsolete. More recently Baumol, in a different context and in terms more compatible with traditional economic thought and language, has tried to explain contemporary market behavior by modifying one of the basic assumptions of microeconomic theory.[27] He concludes that if the assumption of profit maximization is dropped and in its place is substituted the assumption

---

[25] National income data from Martin, *op. cit.*, and United States Department of Commerce; advertising data from *Printer's Ink Marketing Guide*, 1958 annual edition.

[26] Data estimated from chart supplied by Bureau of Patents, United States Department of Commerce.

[27] William J. Baumol, "On the Theory of Oligopoly," *Economica*, August, 1958, pp. 187-198.

that firms seek to maximize their dollar sales subject to a minimum profit constraint, the revamped model explains much market behavior heretofore left unexplained.[28] Baumol's and Berle's approaches, though quite dissimilar, are easily reconciled. Economic theory is not obsolete because the Capitalistic Revolution has brought about the demise of the market economy, but because much of the business behavior traditional theory of the firm attempts to explain is no longer left to market determination. The way business firms will behave with respect to a wide variety of economic incentives has been in part determined in the halls of congress, in the courts, and by executive order and the pressure of public opinion. The market place still functions, but as a matter of public policy the problems resolved there are certainly different, and probably fewer, than they were at the turn of the century; and we very probably still have a preponderance of profit maximizing firms, but their respective maxima are subject to a comprehensive set of constraints.

Finally, because industrial organization has been made so inextricably a part of welfare economics, it would be appropriate to conclude with a tentative judgment as to whether the modern market economy serves better or worse than its earlier counterpart the ends of public welfare. Before any reliable conclusions can be reached on this matter the tools of economic analysis must obviously be sharpened. Until this is done one is, regrettably, left with the less elegant and entirely pragmatic approach. The essential conclusion of this paper is that the discernible changes which have occurred in industrial market performance are attributable not so much to changes in the industrial economy's structure but rather to the adaptation of business decisions to changing economic institutions. The institutional changes have been largely a product of public policy. It follows, therefore, unless the democratic process has itself undergone erosion, that whether modern markets serve better or worse the ends of economic welfare, they presumably perform more in accordance with the public's political and economic preferences.

---

[28] *Ibid.*, pp. 187-88.

CHANGING STRUCTURE OF THE AMERICAN ECONOMY: ITS IMPLICATIONS FOR THE PERFORMANCE OF AGRICULTURAL MARKETS*

WILLARD W. COCHRANE
*University of Chicago***

THE suggested title of this paper is an impressive one. I have pondered at some length the question—how does one inquire into the effects of the changing structure of the American economy on the performance of agricultural markets? But fortunately for you and me, I have discovered a way to avoid both the general and exacting aspects of this problem. My relief comes in the form of being unable to reach any generally useful conclusions, at least for analytical purposes, with respect to changes in the structure of the American economy.

I have reviewed the work of the experts, Markham here, and others including Bain, Stocking, Nutter, Miller, Blair and Houghton and Lintner and Butters, and I come away from their researches and writings more than a little confused. My intuition and some of the findings indicate that market power (i.e., the ability of firms to pursue market policies independent of their competitors) is being increasingly concentrated into the hands of a few firms in some industries, and is becoming a more general phenomenon in others. Most concentration ratios, however, for the period 1940 and thereafter do not bear out this conclusion. Although, here again, most of the experts are unhappy with the resource concentration ratios as measures of the concentration of market power. Perhaps the following statement by Gideon Rosenbluth best summarizes the thinking of the experts with regard to the changing structure of the American economy, and particularly with reference to concentration in recent years. He writes:

> We conclude that while there have been many changes in concentration in particular industries between 1935 and 1947, these changes have been small in most cases, and they show no unity of decision, the average being close to zero.[1]

This conclusion does not provide many good "hand-holes" for analyzing the effects of *changes* in the general structure of the American economy on the performance of agricultural markets. At least this is the way that

* The author wishes to acknowledge the helpful criticisms of A. C. Hoffman, T. W. Schultz, Wayne A. Lee and Robert L. Clodius. Errors of fact, judgment, or logic are, of course, the responsibility of the author alone.

** Visiting professor on leave from the University of Minnesota.

[1] "Measures of Concentration," *Business Concentration and Price Policy*, A Conference of the Universities-National Bureau Committee for Economic Research, Princeton: Princeton University Press, 1955, p. 81.

it appears to me; and this is the way that I shall interpret it in the development of this paper.

I

Although the findings are equivocal as regards general tendencies in the structure of the American economy, such is not the case with respect to the farm marketing system. Numerous writers, particularly Mehren, Collins, Mueller and Davis, have pointed out that some exciting and far reaching changes have occurred during the past 10 years, and continue to occur, in the farm marketing system. Many of these changes have occurred at the retail level, but certainly not all. And it may be that, after the excitement of the current developments has all died away two decades hence, the most dramatic changes will appear to have occurred near the farm level. But it is the thesis of this paper that the key, causal changes in the food marketing system are now occurring at the retail level. And it is the task of this paper to describe these causal changes at the retail level, and trace their consequences through the rest of the farm marketing system.[2]

Some 10 per cent of all grocery stores did 67 per cent of the grocery business in 1957; these were the supermarkets,[3] chain and non-chain, with sales per store averaging over $1 million per year.[4] When the superettes are added to the supermarkets, 32 per cent of all grocery stores made 92 per cent of the total grocery sales in 1957. This leaves 68 per cent of all stores, the small stores, with 8 per cent of the market. This dramatic concentration of food sales is relatively recent. As late as 1952, supermarket outlets had only 43 per cent of the total market and small stores 22 per cent. And in 1940 the supermarkets had no more than 25 per cent of total grocery sales.

In this concentration process chains have not gained relative to independents; chains versus independents has not been the point at issue in this structural change. The chains had 37 per cent of the total grocery sales in 1941, 37 per cent in 1956 and 38 per cent in 1957. The battle line is drawn between large and small stores. Sales in those supermarkets

---

[2] Much of the argument and analytical points of this and the following section grow out of the work of George L. Mehren and Norman R. Collins. See particularly the article by Mehren, "Market Coordination and Buyers' Requirements," *Policy for Commercial Agriculture*, Joint Committee Print, 85th Congress; and the article by Collins and Jamison, "Mass Merchandising and the Agricultural Producer," *Journal of Marketing*, April, 1958.

[3] The definitions developed by the *Progressive Grocer* are used throughout this paper; see the April, 1958 issue page F-6. *Super market*—any store, chain or independent, doing $375,000 or more per year. *Superette*—any store, chain or independent, doing from $75,000 to $375,000 per year. *Independent*—an operator of 10 or less retail stores. *Chain*—an operator of 11 or more retail stores.

[4] *Progressive Grocer*, April, 1958, pages 58-81.

doing over $2 million per year increased by more than 20 per cent in 1957 over 1956, while sales in stores doing less than $75,000 decreased by 3 per cent. And this pattern of change, with minor variations, has occurred every year since the late 1940's. In this context the number of small stores declined from 285,000 units in 1952 to 203,000 units in 1957—a decline of approximately 29 per cent. Whereas the lion's share of the market, 67 per cent of total sales, was shared almost equally between 14,300 independent supermarkets and 14,500 chain supermarkets in 1957.

It might be reasoned that some sort of an oligopsonistic market model, with the resulting less than competitive equilibrium prices and quantities for producers (i.e., farmers) and excessive profits for the buyers (i.e., firms of supermarkets), could be used to describe the performance of markets falling between farm and retail. But such a model does not seem to fit the facts of the situation for several reasons. First, the foremost plank in the market policies of large-scale retail grocery firms is *increased volume*—increased volume is viewed as the direct avenue to profit maximization. All readily observable market practices are geared to sales expansion—not to supply control, not to market restrictionism. Second, although a great concentration process has been at work in the retail food trade in recent years—the market structure of the trade most certainly cannot be characterized as "competition among the few." In 1954, there were some 34,000 retail firms with two or more establishments, and this number could not have changed greatly since that year. Furthermore, the relative gains of chains (i.e., firms with 11 or more units) since 1941, in terms of the proportion of total food sales, would not suggest that a few giant chains were just about to take over the food trade. It will be recalled that the proportion of total sales made by chains since 1941 has held almost constant at 37 per cent. Third, the product flows, the marketing channels, from farmer-producer to food-retailer are so complex and so diverse that monopsony power cannot easily be brought to bear on suppliers.

The bottle-neck situation into which product flows converge, around which a formal market develops, and in which implicit, or explicit, collusion leads to monopsonistic buying practices to the disadvantage of the supplier is hard to find in the farm marketing system. Attempts by a purchasing firm to beat down the price, or to impose other unfavorable purchase conditions, usually means that its source of supply dries up, as the product flows around that firm to more attractive outlets, or resources are allocated to the production of different commodities.[5]

[5] Wayne A. Lee in reviewing a draft copy of this paper rejects this conclusion as well as the substance of the foregoing paragraphs. He writes, "It seems to me that concentration of market power at the retail level is much greater than the statistics on number of chains and independents indicate. I personally feel that the situation is becoming somewhat terrifying."

II

An independent food retailer with a half dozen supermarkets, each grossing a $1 million a year, *does, however, have market power.* And a retail chain with 100 such supermarkets *has even greater market power.* This power grows out of the fact that such firms provide an important market outlet for some product supplier. The supplier *wants* to place his product on, and hold it on, the store shelves of such important market outlets. This is a matter of survival to the supplier in the competitive struggle for product space on the limited shelves of the self-service store. Out of this market situation the retailer derives power, albeit limited power; and based on this limited power the retailer develops and pursues independent procurement policies. This according to Mehren is the pre-eminent development in retailing in recent years.[6]

The question before us, then, is—What does such limited market power and resulting policies convert into with respect to marketing practices? This can best be answered by inquiring into the merchandising goal, or goals, of the food retailers in question. The obvious answer is profit maximization. But this general goal is not analytically helpful; we must be more specific. The overriding goal of modern large-scale food retailers is *increased volume.* The retailer seeks to expand sales as a means of increasing profits, and he seeks to do this in the cultural setting of great consumer mobility, one-stop shopping, self-service, and convenient visual inspection of food products. The means open to the retailer to expand sales in a highly competitive situation, where the possibility of price reductions are limited, are, essentially two: (1) present a product which by its taste, or texture, or coloring, or packaging impels the consumer to pick it up and place it in her basket, and (2) present that eye catching product regularly. Two variables are involved here: one with a quality dimension and one with a time dimension; and they are related. A product with desirable quality and appearance attributes is next to worthless from a merchandising point of view if not offered to the consumer in a timely context (e.g., regularly).

It follows, then, from the nature and objectives of the merchandising operation that procurement policy must be aimed at acquiring a certain and regular supply of a product with desired quality attributes. The market power of large-scale food retailers is used to gain control over two variables—(1) time and conditions of delivery and (2) quality and appearance attributes of the product. Food retailers insofar as they are able (i.e., insofar as their power in the market permits) seek to, and do, specify the content of these two product variables to suppliers.

---

[6] *Op. cit.*, page 291.

The brunt of these procurement policies by retailers has, of course, first fallen on the first supplying agents—the wholesalers. The wholesaling function has in no wise been eliminated, or reduced, in recent years, but it has been increasingly integrated with the retailing function—usually upon the initiative of retailers. Food retailers have increasingly acquired wholesaling facilities, joined cooperative wholesaling groups and entered into contracts with private wholesaling firms in the furtherance of required procurement policy, namely, control over the product variables time and conditions of delivery and quality and appearance attributes. And this, of course, is what we mean by "vertical integration:" the coordination of the decision process in two or more stages of production through management action, rather than through the market.

In other words, the wholesaling function in the food trade has become rather completely integrated into the retailing function. In the language of the trade, wholesaling has made a "good adjustment" to changing market conditions. What this euphemism means, of course, is that wholesaling as an independent, profit seeking venture is disappearing, as the function is increasingly made a part of the retail organization.

It may be argued that too much emphasis is placed on modern procurement policy above, as an explanation of the demise of the independent food wholesaler. A. C. Hoffman, for example, argues that the integration of the wholesaling function into the large-scale retailing operation is to be explained largely in terms of the resulting gains in efficiency in handling the product.[7] Perhaps the Hoffman interpretation is the correct one; certainly he has been close to the development and is a keen observer of marketing phenomena. But it is possible that what the businessman, even the economist turned businessman, calls gains in efficiency "by reason of a closer tie-in between successive marketing stages" under vertical integration (e.g., the elimination of the undependable routeman, or order taker, and the establishment of warehouse facilities conveniently adjacent to retail store outlets) also subsume under what we could call an effective prosecution of modern procurement policy. In other words, unit costs of achieving a certain and regular supply of a product with specified quality attributes are reduced through vertical integration where, for example, the haphazard order taker is eliminated, or warehouse facilities are more conveniently located; this may be called a gain in efficiency, or pursuit of a procurement policy, depending upon your preference.

The great integration battle in the food trade is currently being waged between the large-scale retailers and the national processors and packers.

---

[7] See his paper entitled *The Changing Scene in Marketing and What Producers and Marketing Agencies Must Do to Meet It*, presented before the 1957 National Marketing Workshop, Memphis, Tennessee, November 6, 1957, pp. 4 and 5.

The question at issue is—who is going to integrate whom? There is no question in either camp as to the desirability, or survival value, of product differentiation, quality control, and product eye appeal. The national packers and processors recognize that survival in an independent status rests on their ability to hold their national brands before the consumer. The large-scale retailers, on the other hand, recognize that control of their merchandising policy rests on the establishment of their own private brands and the specification of the quality attributes of their products, which means in turn the reduction of processors to the passive status of present day wholesalers. Thus, the issue is joined and the outcome is still in doubt. And, although it seems to this writer that an important advantage lies with the retailers—in this power struggle, namely, control over the product outlet to consumers, it is not necessary to the argument of this paper to pick, or even know, the final victor. Further, it is possible, perhaps even, probable, that some form of a "live and let live" policy will emerge between the combatants to restrict the range of the battle and limit potential losses. In any event, the remaining large-scale, independent marketing agents will push integration and for identical reasons—the twin imperatives of procurement policy: control over time and conditions of delivery, and control over the quality and appearance attributes of the product.

The question may now be asked—why is the vertical integration of wholesaling and processing activities into the retailing organization essential to the control over the two product variables in question? Why cannot market price effect the necessary integration with respect to these variables? Collins and Jamison provide the answer in general terms:

> ". . . The complexity of the demand function plus the uncertainty surrounding interfirm relationships in general make it difficult, if not impossible, for the producer to translate a price quotation (particularly if this is only an estimate of a future price at time of harvest) first into the set of product characteristics that is implied and then in turn into a set of production operations to achieve this result."[8]

More specifically, first because of the uncertainty that attaches to future farm product prices, second because market prices fail to adequately evaluate and report desired and undesired quality attributes of a commodity and third because quality and appearance attributes are assessed and valued differently among different retail firms, market prices do not, and cannot, effect the integration between production stages required by modern retail merchandising policy. Thus, to gain as complete control as possible over the two variables in question, large-scale retailers have

[8] *Op. cit.*, page 364.

acted vigorously, and continue to do so, to integrate the wholesaling and processing functions into the retail organization.

Markets, providing a nexus between wholesaler and processor on one hand and retailers on the other, have never been noted for their formal structure or institutionalized procedures. But markets of an informal sort have existed in this marketing area. Wholesalers and processors historically have published price lists, and on the basis of such lists orders have been sought and taken. But even such informal markets are withering away under the impact of vertical integration. Purchase of facilities, merger, cooperative affiliation and contracts are replacing the order taker. The operator of a few, or a chain, of supermarkets feels that he cannot afford to wait and order what the order taker may have in stock when he comes around. Aggressive merchandising requires that the operator take the initiative to acquire and maintain in stock those products that the consumer cannot resist plucking off the shelves and stuffing in her basket. In this milieu the "open" market is passing out of existence.

III

Let us now inquire into the extent to which retailer-initiated integration is pushing around local, farmers' markets to encompass farmers as well as middlemen. But first we must recognize that vertical integration has long existed between the processor and farmer in certain vegetable canning crops, and it has come into prominence between the processor and farmer in broilers in recent years. In these, and other instances that could be cited, the initiating force has come from the processor, or first handler, and for the very same reason as those outlined for retailers. Processors have long felt the need for quality control in the complex production and processing processes, and the pressure to acquire a certain and regular source of supply. Control over these variables by processors was a prerequisite to the establishment of national brands, and the widespread distribution of a product of a given quality. Thus, whether the large-scale retailers or the large-scale packers and processors win the integration battle, it seems clear that the production activities of farmer-producers will be increasingly integrated into the processing stage of marketing.

But to return to the question under consideration—Is the integration of marketing activities, initiated by retailers, pushing around local markets and reaching farmer producers? Although the vertical integration process comes unhinged to an important degree at the processing stage at the present writing—with many integration strands running from retailer to processor and fewer and different strands running from processor to farmer—large-scale retailers are beginning to integrate their procurement

activities all the way back to the farmer. This is occurring most often in the fresh fruits and vegetables, but it is also occurring in eggs and poultry and in the red meats. It is occurring wherever retailers have acquired their own handling or processing facilities, or where they clearly dominate small private processors. And it is facilitated at the farm level by large-scale producers, areas of product concentration, and an effective farmers' marketing cooperative.

The extent to which more farmer-producers are tied to processors and first handlers through integration, and the extent to which the operations of those farmer-producers are more closely integrated into the operations of processors and first handlers depends upon at least two sets of factors: those on the producer side and those on the processor-handler side.

The receptiveness of farmers to producing to satisfy a contract rather than for an open market will depend upon their need for capital which in turn is dependent upon the general prosperity of agriculture (it is assumed here that the contracting firm is able to supply the capital or it would not be in business). Second, it will depend upon the effectiveness of the contractual arrangement to reduce, or minimize, price and income risks to farmers. These factors will set the stage, condition the reception, that forgers of the final link of integration will receive at the farm level.

The initiating forces as usual will come from the supply procurement side and in large measure for the same old reasons. The imperatives of (1) a certain and regular source of supply and (2) control over quality and appearance attributes will force the issue. And the greater the need to control these variables at the farm level, the greater will be the push to integrate the production activities of farmers with those of the processor or first handler.

But other considerations may enter from the processor-handler side. If there are great opportunities to reduce product costs, or to produce an eye-appealing product, through fundamental and complex changes in technological or institutional practices, processor-handlers may be expected to initiate such changes through integration. This, of course, is what has happened in broilers and to a lesser extent in turkeys and may be in the offing for hogs. Where a technological revolution in production gives promise of greatly reducing costs, or yielding a superior quality product, and farmers generally lack the capacity to organize and prosecute that revolution, then processors and first-handlers may be expected to initiate the changes through integration.

No man can read the future with certainty, and certainly not this one. But I expect to see in the not too distant future (i.e., before I am a doddering old man), the operations of much of the farm marketing system integrated through contractual and ownership arrangements. The integra-

tion process will be broken in places and will be informal in places; but in fruits and vegetables and the many animal products it will be commonplace. In many cases the initiating action will come from large-scale retailers, and production activities will be integrated from retailer to farmer; in other cases the initiating action will come from processors and integration will run through the processor from farmer to retailer; and in some cases farmers' cooperative marketing associations may integrate forward to the retailer. In this context, institutionalized auction markets and less formal local markets, too, will wither away. In this context, farmers typically will not produce a product of any quality for any time of delivery to an open market; most farmers will produce a product to quality specifications for specific times of delivery.

IV

Cooperative associations have played many roles on the agricultural scene: forcing competition, providing theretofore nonexistent marketing services, purchasing supplies and bargaining.[9] Some of these ventures have been highly successful—in those cases where the need was great, adequate financing was achieved, competent management was secured and farmer-members understood the real problems confronting the association. Where these ingredients in some proportions have been lacking, the ventures have been less successful. But it is possible that farmers' cooperatives have yet to play their greatest role—as business organizations representing independent farmers in the negotiation of, in the bargaining over, contracts with marketing organizations integrated from retailer down in many cases, and processor down in still others. Let me hasten to add, however, that I attach no probabilities to this outcome (i.e., the widespread seizure of this bargaining role by farmers' cooperative). Institutional developments along this line will probably depend upon the extent and generosity of federal credit policies to farmers' cooperatives in the future, and the extent to which farmers generally and clearly appreciate the nature of the marketing problem confronting them.

Whatever the ultimate success of this institutional development, the cooperative prototype, at first, is likely to be the bargaining association as it has developed to confront sugar beet processors and vegetable processors. But it is not likely to long remain such a simple organization; in some cases it may develop its own processing facilities as in the case of

[9] For a keen analysis of the role of farmers' cooperatives in an integrated marketing system see the paper by Willard F. Mueller, "Vertical Integration Possibilities for Agricultural Cooperatives," given before a joint meeting of the American Marketing Association and American Farm Economic Association, Philadelphia, Dec. 29, 1957, and appearing in *The Frontiers of Marketing Thought and Science*, ed. Frank M. Bass, Columbus: Modern Art Co., 1957, pp. 204-15.

fluid milk, and in some others it is likely to develop distributive facilities as in the case of the Sunkist Growers, Inc. Negotiation, bargaining, will remain the central function, but to negotiate effectively such cooperatives may need to establish product handling, storing and processing facilities.

On what kinds of issues will the cooperative be able to represent independent farmer-members effectively in negotiations with vertically integrated marketing organizations? There are many issues, but they group nicely under two headings. They are our same two old variables: time and condition of delivery, and quality and appearance attributes. With respect to the first variable, the following items must go into every contract in some form: the time schedule of delivery, method and schedule of payment, point of delivery, who supplies the harvesting and cartage equipment, and so on. With respect to the second variable, the following points must be settled: varietry of seed or breed stock, feeding rates and rations, disease and pest control, who controls the harvesting schedule, and premiums and discounts for quality and appearance variations.

Negotiation over these variables may seem unglamorous to economists and disappointing to farmers, but there are many points to be settled with respect to each, and the *net* effect of these many decisions can be important to the farmer—to his pocketbook and for his self-respect. And in theory at least, an intelligently managed and loyally supported farmers' cooperative should be able to negotiate effectively on these issues, because no single issue is likely to be as important to the purchasing firm as the continued receipt of supplies from the cooperative in the desired time and quality dimensions. The cooperative gains limited power in the market, power to negotiate effectively with a purchasing firm, as it becomes an important supplier to a purchasing firm of a product with given time and quality specifications. Thus, size achieved through collective action at the farm level brings with it some limited power to bargain.

There is another set of issues, however, on which local, state or even national marketing cooperatives are not likely to be strong bargainers. Those issues relate to prices received by farmers. It is reasonable to assume that every produce buyer comes to the contract negotiation table with an upper limit price in mind—a reservation price based on all known supply and demand conditions. And it is reasonable to assume that a skillful and experienced cooperative negotiator can approximate the buyer's reservation price. But, once the cooperative pushes its selling price above the buyer's reservation price, the cooperative will have pushed itself out of that market. This follows from the fact that the purchasing firm can obtain its supplies from another cooperative, a large private producer, or by entering into agricultural production itself. Locating a new and desirable source of supplies might prove annoying, might even involve some extra

costs, but it can be done; that is the important point in this context. A higher than going price, or readily acceptable price, can only be made to stick where the purchaser does *not* have alternative sources of supply. And unless some general scheme of supply control with the force of government behind it is embraced by farmers, it is difficult to see how the typical integrated buyer won't have many sources of supply for many years to come. Thus, the bargaining power of farmers' cooperatives, unless buttressed by state action as in the case of fluid milk, has been and will continue to be weak with respect to price. In the typical case a farmers' cooperative cannot control supply; it is as simple as that.

Mueller states the proposition even more pungently:

> ". . . Once and for all let us recognize that vertical integration per se does not give a cooperative or any other firm market power. Market power is built of different stuff. It depends upon a high degree of horizontal concentration or product differentiation. . . ."[10]

Referring to such vertically integrated associations as Sunkist Growers, Inc., Sun Maid Raisin Growers and Diamond Walnut Growers, each of which has marketed as much as 70 per cent of their industry's supplies, Mueller goes on to say:

> ". . . None has the essential prerequisite of market power, the ability to limit supply. . . . Market power depends upon control over the supply of the product passing through the system, not just on ownership of the marketing facilities through which it passes. . . ."[11]

We have, prior to this section, been describing a situation in which vertical integration, deriving its force out of the desire and capacity of large-scale retailers to control two mechandising variables, is pushing its way all the way back to the farmer. In this changing structure the open, auction type of market is becoming a casualty all along the line. Production activities are becoming increasingly integrated through contractual and ownership arrangements, rather than through open markets. But in the last stage of integration, at the farmers' level, we witness the emergence of a new power, *a countervailing power,* in the form of farmers' cooperative action. This power is limited, as is the power at the retail level, which it is the thesis of this paper, started the whole integration business.[12] At neither end of the line is market power absolute; at neither end of the line can the agents involved control price. But farmers acting through

---

[10] *Ibid.*, p. 208.
[11] *Ibid*, p. 211.
[12] The fact that vertical integration appears on the historical scene earlier at the processor level does not spoil the argument. It occurred at the processing level for the same reasons that it is occurring at the retail level. But integration stemming from retailer action is the general, classical case.

their cooperative associations—associations that we see in being already in fruits and vegetables and are being talked about and initiated in hogs—can use their limited market power to moderate and blunt, hence influence, actions taken by purchasing firms with respect to the variables time and conditions of delivery and quality and appearance attributes of the product.

A new type of market is, thus, beginning to take shape at the farm level, a bargaining market, in which farmers are using in some instances, and are learning to use in other instances, the limited power of cooperative action to countervail against the typically greater but still limited power of large-scale vertically integrated purchasing organizations. It will remain a market so long as farmers remain independent agents. And they will remain independent agents in the tide of vertical integration so long as they manage and run their cooperative bargaining associations wisely.

V

In bringing this paper to a close, I want to touch briefly on one important question raised by the broadening and deepening of vertical integration. It is—will the farm surplus problem pass away, as a general problem, under the institutional complex envisaged above?

It has been argued on occasion that the general and chronic surplus problem of American agriculture would cease to exist in a vertically integrated farm marketing system. Perhaps so, but probably no. If our visage of the ultimate farm marketing system is one of three, or four, giant chains doing all the retail grocery business, with clean, integrated strands of productive activity stemming back from each retailer through the wholesaling and processing operation to the farmer in each food line—then, perhaps the surplus problem would be solved. Each of three or four large retail chains in this world could accurately gauge the total market for a food product and its (the firm's) share of the total market, and transmit this knowledge back through the system in the form of contracts to farmer-producers to yield the quantities necessary to fill out their shares of the market. In other words, where a few retailers share the total food market, they can know and stabilize those shares and contract for just those quantities required to satisfy their shares. In this neat world there can be no surplus problem; other problems yes, but no surplus problem.

But is the farm marketing system likely to become so structured in our lifetimes? I doubt it. I expect the farm marketing system to become integrated to an important degree through contractual and ownership arrangements within a decade or two. But it can remain a pretty complex, disorderly affair under the dominance of such institutional arrangements. Certainly there are going to be several thousand retail firms for a long

time to come. Some of these retail firms are going to integrate back to the farm level; others are not. Some independent processors and packers with well-integrated operations seem destined to stay in the picture. And some farmers' cooperatives are going to push toward the retailer with integrated operations.

In this institutional complex market shares cannot be known, hence total contracted quantities cannot equal total retail sales in any given period except by chance, or through inventory accumulation or de-accumulation (supply control, and sales quotas under governmental sponsorship are assumed away here). In the context of market uncertainty with regard to shares of the market at all stages, farmers may be expected to produce on their own account, cooperatives accept supplies not contracted for, and purchase contracts to remain flexible with respect to total quantities, in the event that sales in a particular commodity, or through a given firm, turn out to be greater than prior operational estimates.

In a context of market uncertainty all agents in the marketing system will remain "flexible" as regards quantities, and farmers will keep right on producing in the hope of finding a market outlet. In short, physical surpluses will remain the order of the day, if the government seeks to support farm income. And if it does not, returns to farmers can be expected to be disastrously low for a long time to come, since one of the important by-products of vertical integration will certainly be a speed up of an already revolutionary rate of farm technological advance.

Nothing short of supply control, with national sales quotas under government auspices, is going to permit many thousands of firms, regardless of how they are linked together, to adjust supplies *to* demand at a price defined as fair. Given a market structure of *competition among the many* the pressure, the incentive, on everyone is to expand output; no one has the responsibility, or obligation, to adjust downward, except as adjustment is thrust upon him through business failure. Thus, vertical integration, or no, it is inconceivable for me that any group of producers can endure a situation when the pressures to expand output are as great as they are in agriculture and the demand elasticities are so low. Either all of us must pick up the check of price and income support for agriculture, as we are now doing, or farmers must accept supply control.

SOME MARKET STRUCTURE CONSIDERATIONS IN ECONOMIC DEVELOPMENT

WILLARD F. MUELLER
University of Wisconsin

THEORIES of economic growth are concerned with isolating the bases of economic betterment of areas or countries. Economic betterment refers to an over-all improvement in economic wealth, but it cannot ignore the way in which such greater wealth is distributed.

To date, growth theories have been fragmentary. Usually they stress some strategic variable related to growth, such as population, natural resources, capital formation, the sources of innovation, and institutional barriers or stimuli to growth. Sometimes they only are peripheral to theories developed to explain other economic phenomena, e.g., Keynes' stagnation theory which was really concerned with explaining chronic unemployment, not with the rate of growth of capitalistic economies.

As Williamson has said, "A really satisfactory theory of economic growth would identify the principal factors in the process and indicate the extent to which they are relatively dependent or independent variables; it would furnish the analytical tools necessary to show causal relations; it would be susceptible to empirical vertification; and it would not be restricted temporally, spatially, or to any particular cultural or institutional pattern."[1]

This is a big order, and I am certainly not going to fill it today. But as I review the literature on this subject, I am becoming increasingly impressed by the way in which many theories deal mainly in aggregates, implying that growth will result if this or that variable is manipulated, e.g., the rate of capital accumulation. While such broad treatment of growth processes has merit for many purposes, it does ignore, or abstract from, the market structure and organization within which the relevant variables presumably work themselves out.[2] This observation has led me to conclude that market structure analysis is an underdeveloped tool of economic growth theory.

Today I wish to focus my remarks mainly on: (1) why study of market structure is important in understanding economic development problems, (2) some observations on the market structures of underdeveloped economies, and (3) some implications of the market structures found in such economies.

---

[1] Harold F. Williams in Bernard F. Haley (ed.), *A Survey of Contemporary Economics,* Volume II, Homewood, Illinois: Richard D. Irwin, 1952, p. 181.

[2] There are notable exceptions to this generalization, especially in the empirical work of recent years. Much of the discussion below draws from these studies.

Why Study Market Structures of Underdeveloped Economies?

Study of marketing systems becomes important as soon as a community rises above subsistence levels. The most unique feature of the early stages of economic development is the emergence of a market economy. And the early progress in this direction is slow and hard. Characteristically, the first goods available for market represent a meager, uncertain, and low quality supply. Furthermore, producers may be located substantial distances from ultimate consumers. Marketing this initial surplus is a costly job. Assembly involves procuring supplies in very small lots from vast numbers of small producers and transporting them great distances to market. For example, groundnuts are grown by hundreds of thousands of Nigerian farmers, most of whom supply less than one-half ton for market. Generally, these producers are located about 800 to 1,000 miles from ports and often hundreds of miles from the closest railheads.[3]

At the other end of the distribution channel in underdeveloped countries we find consumers who typically buy in very small amounts. For example, in Nigeria some common lots of retail purchases are, "three lumps of sugar, half a cigarette, individual drops of perfume, and a few sticks of matches."[4]

Given such supply and demand conditions, marketing necessarily is an expensive business. But because so much of the economic development job ultimately rests on specialization of production for sale to others, marketing assumes a crucial role even in the earliest stages of the development process. In truth, the very rate at which an exchange economy emerges is inherently paced by the performance of its marketing institutions. Obviously nearly anything relating to the effectiveness with which the marketing tasks are done becomes a potentially strategic variable in the economic development process.

This raises the question of market structure and its relevance to market performance and behavior. Economists are concerned with the structure and organization of industries because they suppose that firm and industry performance are, in part, a function of these variables. The classical view was that a competitive structure constituted the engine of progress and a monopolistic one the brake. This view has not survived unchallenged. In fact, Schumpeter turned this reasoning inside out and claimed that economic progress was incompatible with perfect competition, and that monopoly not only permitted, but was prerequisite to innovation—which to him was the mainspring of economic progress.[5]

[3] P. T. Bauer, *Economic Analysis and Policy in Underdeveloped Countries,* Durham: Duke University Press, 1957, pp. 67-68.

[4] *Ibid.,* p. 68.

[5] Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy,* New York: Harper & Brothers, 1942, especially Chapters 8 and 9.

These conflicting views, by no means, have been reconciled to date. The persistence of this conflict stems, in part, from the fact that reliable quantitative testing of these alternative hypotheses is so very difficult. For example, in attempting to test his hypothesis that competitive structures best promote economic growth, Stigler found that economic development (as measured by the decline in the labor requirement per unit of output) was most rapid in industries with declining concentration.[6] But, unfortunately, his evidence also supports the hypothesis that concentration tends to decline in industries experiencing rapid increases in technology and demand.

Although students of market structure do not always agree as to which tools to use in working on their problems, they have forged a formidable set of tools during the past three decades. I am sure that if students of economic development inspect them they will find some suitable for working on their problems. Certainly anyone who feels that the model of pure competition is an inadequate tool in analyzing the performance of American industries will be equally, or even more, dissatisfied with it in understanding the market performance of underdeveloped economies.

The Market Structure of Underdeveloped Areas

Cochrane and Markham have discussed the market structure of the American economy and its effect on performance. Everyone will not agree entirely with their characterizations of this structure or the degree to which it promotes or limits American industrial performance and growth. But certainly few will say the structure of the American economy and its performance are unrelated variables. And those who agree that industrial performance is, in part, a function of structure will not ignore the fact that industries in underdeveloped areas generally have more concentrated market structures or are more plagued with monopolistic competition than are American industries.

Although data are scanty on the market structures of underdeveloped economies, one may make some generalizations based on a variety of published sources. The following discussion will deal with some aspects of the market structures of the following broad market classifications: (1) wholesale and retail markets for food; (2) manufactured goods markets; (3) export and import markets; and (4) money markets.

Assembly and wholesale markets for food

Published works dealing with these markets suggest a wide range of marketing methods, types of middlemen, and market structures. Solomon generalizes that in fresh produce, peasants mainly deal directly with

[6] George J. Stigler, "Industrial Organization and Economic Progress," in Haryer J. Levin (ed.), *Business Organization and Public Policy*, New York: Rinehart & Company, 1958, p. 133.

individual retailers or consumers. He concludes that, "These individual bargaining transactions . . . approach the nature of isolated exchanges, with the exact location of each transaction's price depending on the two parties' indifference curves and bluffing abilities. . . ."[7]

Studies of Jamaican, Indian, West African, and Puerto Rican[8] marketing conditions suggest striking similarities in food market structures. These studies suggest that most commonly food wholesaling and retailing are carried on under conditions best described as monopolistically competitive (Chamberlin's large numbers case). Typically, there are a relatively large number of wholesalers and retailers selling differentiated products or services. This differentiation is permitted and encouraged by several things especially common to underdeveloped economies. The relative immobility of buyers and sellers exaggerates locational differentiation; the considerable reliance of many buyers and sellers on credit invites credit differentiation; segmentation of the population into economic or social caste systems provides unique opportunities for differentiation; inadequate market information permits differentiation based on market ignorance. These, plus other factors unique to particular areas, provide the demand conditions conducive to monopolistic competition. On the other hand, in these economies it is relatively easy to enter many phases of food wholesaling and retailing because of the low ratio of capital to labor required to carry out many marketing jobs. Moreover, often relatively low levels of technical and administrative skill are needed to perform certain wholesaling and retailing functions. Given such entry conditions, any suggestion of high profits in marketing brings additional middlemen into the picture. The result may well be what the Chamberlinian model suggests, that is, none of the marketing middlemen are making excess profits, but marketing margins are larger than if differentiation were less.

Since product differentiation in most phases of wholesaling is less common than in retailing, it does not act as such a serious restraint to large-scale operation. For example, whereas Puerto Rican retailers are only about one-fifth as large as those on the mainland, Puerto Rican wholesalers are about two-thirds as large as their American counterparts.[9]

---

[7] Morton Solomon, "The Structure of the Market in Underdeveloped Economies," in Lyle W. Shannon (ed.), *Underdeveloped Areas: A Book of Readings and Research*, New York: Harper & Brothers, 1957, p. 133.

[8] Sidney W. Mintz, "The Role of the Middleman in the Internal Distribution System of a Caribbean Basant Economy," *Human Organization*, Volume XV, Summer, 1956, pp. 18-23. R. K. Hazari, "Monopolistic Competition and Welfare in Underdeveloped Countries," *Indian Journal of Economics*, Volume 33, 1952-53, pp. 425-432. P. T. Bauer and B. S. Yamey, "Economics of Marketing Reform," *Journal of Political Economy*, Volume 62, 1954, pp. 210-235. J. K. Galbraith and Richard Holton, *Marketing Efficiency in Puerto Rico*, Cambridge: Harvard University Press, 1955.

[9] John K. Galbraith and Richard H. Holton, *Marketing Efficiency in Puerto Rico*, Cambridge: Harvard University Press, 1955, p. 173-174.

Another interesting feature of wholesale food markets is the considerable amount of vertical integration of the nonownership type (better known as "contract farming" in American agriculture) existing in them. This should interest agricultural economists because of their current interest in this subject. Perhaps economists may even learn something about the causes and implications of vertical integration for American agriculture by observing its operation in economies which in some respects are less complicated than our own.

The chief bases of such integration in underdeveloped economies is the need for credit by producers and certain middlemen. Consequently, buyers of farm products with large capital resources are able to use credit extension as a market strategy to obtain their supplies under the most advantageous conditions. After such credit extension becomes a common practice in an industry, the ability to extend credit becomes a necessary prerequisite to entry into food wholesaling. For example, Bauer reports that in West Africa, "the ability to make cash advances to producers has been an important prerequisite of successful entry into produce buying, especially in the purchase of cocoa and groundnuts."[10] If the requirements of credit for this purpose become large, they may act as an effective barrier to entry by increasing the ratio of capital to labor required to perform the marketing function. The result may well be the transformation of monopolistically competitive industries into oligopolistic ones. This is not unlike what one may expect to happen as contract farming hits some monopolistically competitive segments of American agricultural marketing.

Another apparent reason for vertical integration in underdeveloped economies is that marketing middlemen may see opportunities in agriculture which farmers themselves do not recognize, or are unable to adjust to without help. Then the middleman may extend credit and other assistance to the farmer to assure himself an adequate supply of the product. For example, Bauer reports that a Hausa trader played a crucial role in the economic development of the Nigerian groundnut industry by inducing growers to try this new venture. Bauer concludes, "His activities and success are examples of the results of superior perception of economic opportunity."[11]

The manufacturing industries

Manufacturing industries outside the United States generally are more concentrated and cartelized than are their American counterparts.

[10] P. T. Bauer, "Concentration in Tropical Trade: Some Aspects and Implications of Oligopoly," *Economica*, Volume XX, 1953, pp. 305-306.

[11] P. T. Bauer, *Economic Analysis and Policy in Underdeveloped Countries, op. cit.*, p. 76.

This seems true even of other highly developed economies. The cartelization of many Western European and Japanese industries is well known. Even Canadian and British industries are more concentrated than are American.[12]

In less developed economies the differences are even more striking. Consider the case of India, which in many respects is the free world's key underdeveloped nation.

Interestingly, the structure and organization of Indian manufacturing industries are similar to that of much American industry in the late 19th century.[13] Indian Management agencies are similar in many respects to the pre-Sherman act, American trusts and holding companies. These agencies control, finance and manage much of India's industry. For example, nine leading British Managing agency houses control 250 industrial concerns and 11 Indian houses control 220. Often these houses control diverse interests. Yule and Company controls 10 jute mills, 17 tea companies, 10 collieries, one sugar mill, one paper mill, two electricity, two engineering and six miscellaneous companies. As a result of such diverse holdings, control of many Indian industries is concentrated in relatively few hands. Of India's and Pakistan's 25 cement factories, two managing houses control 20. One concern accounts for over two-thirds of India's match industry. Over 90 per cent of India's iron and steel capacity is controlled by Martin-Burn and Company and Tata Industries, Ltd. Tata also owns and has interests in firms in textiles, transport, chemicals, oils, insurance, electric power, printing, and miscellaneous other fields. Here is a prime example of Edwards' "conglomerate firm" along with all of its interesting implications for market behavior.[14]

The performance of Indian firms is further influenced by the practice of extensive multiple directorships. Two Indian families hold directorships on 200 firms. Seven others hold another 400. In fact, 30 persons hold as many as 860 directorships and 100 as many as 1,700. This feature of industrial organization cannot help but spread a web of common interest and behavior over much of India's industry.[15]

---

[12] Gidean Rosenbluth, "Industrial Concentration in Canada and the United States," *Canadian Journal of Economics*, Volume XX, 1954. H. Leak and H. Marzets, "The Structure of British Industry," *Journal of the Royal Statistical Society*, Volume CVIII, 1945.

[13] The following description of the structure of various Indian industries is based on M. M. Mehta, *Structure of Indian Industries*, Bombay: Popular Book Depot, 1955, pp. 245 ff.

[14] Corwin Edwards, "The Conglomerate Firm," in G. J. Stigler (ed.), *Business Concentration and Price Policy*, Princeton: Princeton University Press, 1955.

[15] Apparently this represents a higher degree of interlocking of directorships than exists in the United States. *Cf. Report of the Federal Trade Commission on Interlocking Directorates*, Washington: 1951.

Another significant feature of Indian industry is the extent to which leading industrial concerns have become integrated with the country's leading financial institutions. Commonly, the Managing houses attain control or close working relations with banks, insurance companies, and investment trusts through common directorships or by actually acquiring controlling interests in them. This would seem to be opposite from the relationship existing in American industry around 1900 when leading financial institutions often exercised considerable control over industrial concerns.

These brief observations on the structure of Indian manufacturing industries suggest the existence of an extremely high degree of ownership and nonownership integration. This characterization of Indian industry has prompted a leading authority on Indian industrial structure to observe, "It is, indeed, very unfortunate that in a vast and potentially rich country like India a few leading Managing agency houses should exercise overwhelming control over a major portion of our industrial productivity."[16]

It is likely that the concentrated structure and organization of India's manufacturing industry is not atypical. In fact, it is likely that—because of its relatively larger internal market—it actually enjoys less concentration of control than most other underdeveloped economies.

There are various reasons for such considerable concentration in underdeveloped nations. Certainly, in countries with very limited markets, the size of the market coupled with significant economies of scale in plant dictate fewer plants than there are in comparable American industries. But this is by no means the only reason for high concentration. And it would be a mistake to conclude that smaller markets inevitably mean higher concentration in underdeveloped economies than in America. Actually there are economic forces which may make the optimum-size manufacturing plant a much smaller unit than commonly found in more advanced economies. Labor-intensive technology which is encouraged by very low wage rates, usually encourages—or at least does not discourage—smaller-scale units than does capital-intensive technology. Furthermore, because capital markets in underdeveloped economies are not highly organized, it is difficult to get large amounts of capital for a single purpose; it is easier to raise private capital for a number of small businesses than for a single large one.[17] Of course, these factors are less important in capital goods manufacturing than in consumer goods manufacturing because in the former modern technology may not permit very extensive

[16] Mehta, *op. cit.*, p. 249.

[17] Henry G. Aubrey, "Small Industry in Economic Development," *Social Research*, Volume XVIII, September 1951, pp. 270-312.

substitution of labor for capital. In this event, firms requiring large capital investments may inevitably lead to monopoly or oligopoly in underdeveloped areas.

But there are other reasons for the high degree of concentration associated with underdeveloped nations. Often, it may simply be the relative newness of an industry, which inevitably creates high concentration in the short run. Also, when capital requirements are large, we may expect this to be an especially critical barrier to entry in underdeveloped nations. Another common barrier to entry may be government policies which officially or unofficially protect a firm's monopoly position, either as a reward for entering the market in the first place, or, simply as a special political favor. The point is that there is not a single simple explanation for particular market structures in underdeveloped economies just as there are not simple explanations for those of the more developed nations.

Structure of export and import markets

These are especially crucial markets because underdeveloped countries are dependent on them for many of the capital goods needed for growth and as outlets for their raw products. It is difficult to generalize about these markets because data on them are scarce. But apparently imports and exports of underdeveloped countries are channeled through a relatively small number of trading merchants. For example, in 1949 the largest Nigerian importing house handled 34 per cent of the major commodities imported. Its share of these varied from a low of 16 per cent of rayon piece goods to 74 per cent of cigarettes.[18] In most commodities the two largest importers accounted for over half of all imports. Moreover, the largest importer was also the largest exporter; and the two largest exporters accounted for most exports.

The structure of the import and export markets of Ghana (formerly the Gold Coast) is very similar to that of Nigeria.[19]

The structure of import markets is especially important in underdeveloped economies because imports often are the chief constraint on local monopolies. However, not infrequently domestic manufacturers are also involved in importing or in some way tied in with world suppliers of their products. For example, before World War II, Du Pont and Imperial Chemical Industries, Ltd., of England, owned a number of jointly-owned chemical manufacturing and importing businesses in various countries. Not only did they own the largest chemical companies of Argentina, Brazil, Canada, and Chile, but through cartel arrangements with other of the world's leading chemical concerns they controlled prices or divided

[18] P. T. Bauer, "Concentration in Tropical Trade: Some Aspects and Implications of Oligopoly," *Economica*, Volume XX, 1953, p. 309.
[19] *Ibid.*, pp. 319-320.

world markets for various chemical products.[20] Because of the possibility of such arrangements, the monopoly power of domestic manufacturers may not be seriously constrained by imports from the world market.

The structure of money markets

The premium placed on capital in underdeveloped areas makes the structure of the money market especially important. Many of the structural characteristics of other industries are ultimately related to the character of the financial institutions and to the people's perennial need for credit extension.

One of the great needs in underdeveloped economies is to concentrate savings so as to accumulate enough capital at one place and time to be able to finance costly development jobs. But unfortunately much, and perhaps most,[21] of the available savings are located in rural rather than urban areas. "The merchants or middlemen who finance innumerable small manufacturers in Asia are located for the most part, in small towns or villages."[22] Thus, underdeveloped areas tend to have very decentralized capital markets. This may cause a number of problems. First, adequate funds often are not concentrated at one place to finance really big projects. Second, geographic isolation due to poor transportation and communication may give some lenders important local monopolies. Also, if lenders are very decentralized they may be less sensitive to general economic conditions than they would be if they were branches of a national banking institution. This could become an important obstacle to an effective monetary policy.

Indian planners have recognized the need for a more concentrated market structure in banking; in fact, its Reserve bank has a definite policy favoring greater concentration.[23] Recently a number of Indian banks have merged and significant steps apparently are being taken to achieve a more concentrated banking structure.[24] Of course, insofar as dominant manufacturing interests exercise control over leading financial institutions, as they seem to in India, increased concentration in banking may lead to additional over-all concentration of economic power.

Some Implications of Market Structures of Underdeveloped Economies

The preceding discussion has touched briefly on only a few significant characteristics of market structures of underdeveloped economies. But

[20] Willard F. Mueller, "Du Pont: A Study in Firm Growth," Unpublished Ph.D. dissertation, Vanderbilt University, 1955, pp. 232-266.

[21] Aubrey, *op. cit.*

[22] *Ibid.*, p. 221.

[23] Y. Seshagiri Rao, "Concentration of Banking Power in India," *Indian Journal of Economics*, Volume XXXIII, 1952, pp. 41-48.

[24] *Ibid.*

available evidence strongly suggests that these market structures not only depart from purely competitive ones, but they depart further from competitive structures than do those of American industry. Certainly anyone who believes that there is a relationship between market structure and economic performance, progress, and development will be particularly interested in the implications of these structures. They must be considered among the strategic variables in economic development. Time permits only a few observations on the implications of these market structures to economic development problems.

Market structure and industrial performance

Among the least understood facets of the development process are the origins or stimuli to proper incentives for the economic behavior necessary for development. Kindleberger has observed, "Many economies, for reasons not always clear, make an effective start along the commercial revolution and reach a stage at which further progress of a spontaneous character seems impossible."[25] He then mentions two apparent reasons for this: Undue concern with a high profit rate and the widespread adoption of a speculative psychology.

Leibenstein makes a similar observation but develops it in terms of Von Neumann's and Morgenstern's "theory of games."[26] He points out that a player is interested in either zero-sum games or non-zero sum games. And, if reliance is placed on the profit motive to stimulate performance, there is no *a priori* basis for concluding that players will prefer positive-sum to zero-sum games.

Applying this to economic development, there is no certainty that firms will prefer positive-sum behavior, that which increases over-all wealth, to zero-sum behavior, that which has only a distributive effect. Thus, an adequate theory of economic development would explain the sources of positive-sum incentives.

Customarily, development theories explain the tendency toward zero-sum activity in terms of peculiar cultural conditions or economic uncertainty found in underdeveloped nations. But it seems to me that analysis of market structure and performance promises to be an extremely fruitful area of research into the sources of positive-sum incentives. Given the monopolistic or cartelized industries apparently common to many underdeveloped nations, it seems entirely probable that zero-sum activity

---

[25] Charles P. Kindleberger, *Economic Development*, New York: McGraw-Hill, 1958, p. 105.

[26] Harvey Leibenstein, *Economic Backwardness and Economic Growth*, New York: John Wiley & Sons, 1957, p. 112 ff.

will be the main order of the day. "The perennial gale of creative destruction," which Schumpeter envisioned as undermining monopolistic strongholds, seems to be blowing quite effectively over many American firms, thereby creating an atmosphere conducive to positive-sum behavior. But our industrial structures apparently are vastly different from those of underdeveloped nations. Intraindustry and interindustry competition likely are not as effective in spurring positive-sum behavior if numerous firms and even industries are controlled by a conglomerate enterprise like Tata in India. This suggests that Schumpeter's gale blows less severely over the underdeveloped lands.

The possibility that market structure differences may be as important as cultural ones in explaining behavioral differences between underdeveloped and American industries seems like an intriguing hypothesis worth testing.

Market structure and market reorganization

Another implication of the market structures apparently extant in underdeveloped areas is that economists working in underdeveloped nations should consider market structure as a key variable in development programs. Several interesting studies along these lines already have been made, especially of the causes and implications of the monopolistically competitive structures of the food industries. Some of these conclude that such structures not only are inevitable but are not hampering efficient market performance and, hence, economic development. Bauer and Yamey are the most sanguine in this respect. They apparently are able to find little that is bad—in terms of long-run performance—with present noncompetitive structures of underdeveloped economies.[27] The point they seem to miss is that until some of the commonest causes of monopolistic competition are eliminated, efficient marketing systems are impossible. The introduction of such fundamental reforms as adequate grading systems, weights and measures, price information, and laws spelling out the rights and obligations of contract, will elimiate many of the monopolistically competitive features of these markets.

In contrast to Bauer and Yamey, Galbraith and Holton not only find that present Puerto Rican market structures perform unsatisfactorily, but suggest a number of ways of altering them so as to improve their competitive performance.[28] Their suggestions include: consumer and retailer education, establishment of food chains and consumer cooperatives, direct government intervention, and other structural changes. They also con-

[27] P. T. Bauer and B. S. Yamey, "Economics of Marketing Reform," *Journal of Political Economy*, Volume 62, 1954, pp. 210-35.

[28] Galbraith and Holton, *op. cit.*, pp. 177 ff.

sider, but do not recommend, price and margin controls and control of entry.

Because so little empirical work has been done on market structures of underdeveloped economies, I would heartily commend this area to marketing economists. My only advice is that they look over the ever growing kit of market structure concepts to see if there are some to their liking.[29]

Market Structure and Political Attitudes Toward Private Enterprise

Understanding of the market structures common to many underdeveloped nations should make it obvious why many of their people are so hostile to the concept of private enterprise. I would suggest that often this hostility has, at least in part, a market structure basis. To these people capitalism is often equated with monopoly and all the bad things monopoly implies. This also explains partly why American free enterprise is so hard to export. And I dare say that even the performance of American firms' foreign subsidiaries often differs greatly from that of their American located parents. It is not that American managers become different people when they go abroad, rather, they may simply behave differently because their market structures are so different. Also in this vein, when private foreign importers and other industries are highly concentrated, it raises a question as to the appropriateness of our foreign aid programs (such as Public Law 480) which specify that the United States work through private foreign concerns whenever possible. Such policies evidently are justified on grounds that American private firms perform effectively enough and certainly better than publicly-run enterprises. But since there may be very substantial differences between the performance of private concerns in America and in other nations, generalizations from American experience may be inappropriate bases for our foreign polices.

In conclusion, let me emphasize that this discussion admittedly has touched on only a few of the many interesting market structure considerations in economic development. Other challenging areas demanding inquiry include the effect of market structures on income distribution, on capital accumulation, on short-run resource allocation, and the special problems they create for monetary policy. My main purpose today has been to stimulate more thinking and research on what I believe to be an exciting and a potentially productive—but as yet a truly underdeveloped—area of economic development analysis.

---

[29] Recent papers like the following might suggest some ideas on this score: Willard W. Cochrane, "The Market as a Unit of Inquiry in Agricultural Economics," *Journal of Farm Economics*, February, 1957, pp. 21-39. Robert L. Clodius, "Developing Buying Policies in Decentralized Assembly Markets," *Journal of Farm Economics*, December, 1958, pp. 1541-1550. Paul E. Nelson, Jr., "Altering Marketing Concepts to Modern Conditions," *Journal of Farm Economics*, December, 1958, pp. 1511-1522.

DISCUSSION: CHANGING STRUCTURE OF THE AMERICAN ECONOMY: ITS IMPLICATIONS FOR PERFORMANCE OF INDUSTRIAL MARKETS

WALTER ADAMS
Michigan State University

"THE essential conclusion of this paper," says Markham, "is that the discernible changes which have occurred in industrial market performance are attributable not so much to changes in the industrial economy's structure but rather to the adaptation of business decisions to changing economic institutions." Changes in performance are to be explained by such institutional factors as "the federal corporate income tax, the antitrust laws, the Federal Reserve system, full employment policies, the periodic Congressional investigation of industry, the exercise of moral suasion by government, and the present corpus of law governing labor relations, resale price maintenance, agricultural and strategic materials prices, and social security." The oligopolists of today, Markham suggests, operate in a different environment. They are restrained from raising prices in times of general inflation—not because they lack the power to do so, but because they fear "the close scrutiny of Congress, a possible slap on the wrist from the President, and almost unfavorable review by the press and Walter Reuther."

These assertions are supported neither by analysis nor empirical evidence. Nowhere does Markham indicate what changes in performance have actually taken place, or precisely how these changes have come about. Nowhere does he demonstrate how, in particular industrial markets, performance is qualitatively or quantitatively altered by particular institutional forces. He leaves us with little more than the suggestion that in some way and to some extent exogenous factors influence market performance—hardly a startling revelation.

For some time, students of industrial organization have known that structure, conduct, and performance are intimately related. (By structure, I mean the organizational anatomy of a market; by conduct, the behavioral interaction of firms—their strategy, tactics, and practices; by performance, the market results—measured in terms of efficiency, progressiveness, etc.) This trinity of variables is much like the marbles in the Marshallian bowl. Change the position of one, and you affect the position of the others. Put differently, changes in structure and/or conduct will tend to bring about changes in performance.

Institutional forces have an impact only insofar as they operate through structures or conduct or both. Prorationing, for example, has no magic or direct effect on performance. Rather, it modifies and mitigates market

rivalry among the oil companies (conduct) and thus influences market results. The disposal of surplus aluminum plants has an impact on structure and, through it, on performance. The relevant question, therefore, is: "what changes in market structure or behavior are likely to produce what changes in the performance of particular markets?" This is the crucial question, if we are to understand the operation of industrial markets and to formulate meaningful government policies. The corporate income tax and social security may significantly influence behavior, and hence performance, in an oligopolized industry, but Markham does not tell us how or how much.

To the extent that industrial organization is a normative discipline we should attempt, *first,* to devise meaningful criteria for measuring performance; *second,* to determine, analytically and empirically, the structural and behavioral characteristics conducive to "good" performance; and *third,* to develop institutional modifications of structure and conduct, designed to attain the desired performance norms.

Until this is done, we should continue to regard the structural implications of oligopoly as a more significant determinant of performance than moral suasion, a vigilant press, Congressional scrutiny, and Walter Reuther. Steel is a case in point. Here is an industry which reaches the break-even point in profits (measured as return on net worth after taxes) when operating at about 40 per cent of ingot capacity. (Senate Report Number 1387, 85th Congress, p. 46) Prices are high and rigid, bearing little relationship to changes in demand or in costs. According to the Kefauver Committee, the steel-price index since World War II "continued its virtually unbroken rise even when demand and production declined (as they did in 1949, 1954, and 1957). It also continued its climb when unit labor costs declined (as they did in 1950 and 1955). No matter what the change in cost or in demand, steel prices since 1947 have moved steadily and regularly in only one direction, upward." (*Ibid.*, p. 129) The fact that prices were again increased in 1957; that the price increase substantially exceeded the cost increase; that the higher prices were subsequently maintained in the face of declining demand, operations at less than 60 per cent of capacity, and a general recession—this "is a tribute to the perfection with which price leadership in the steel industry maintains price rigidity." (*Ibid.*) It lends further support to George Stocking's conclusion that the steel industry's structure "contributed to conduct incompatible with an effective interplay of market forces," and that "its structure and conduct resulted in unacceptable performance." (*Yale Law Journal*, July, 1955, p. 1136)

The automobile industry is another example of how structure influences conduct, and how both determine performance. Here, General Motors pro-

duces roughly 50 per cent of the output, and the "Big Three," 96 per cent. General Motor's prices are designed to yield—over the long run and on the assumption of operations at 80 per cent of capacity—an average profit after taxes of 15 to 20 per cent on invested capital. The fact that, between 1940 and 1956, the company was able to meet this target figure—its profits ranging from a low of 19 per cent to a high of 37.5 per cent—indicates that General Motors not only possesses, but exercises considerable market power. That it serves as the industry's price leader, and is willingly followed by its rival oligopolists, is dramatically illustrated by the following incident: On September 29, 1956, reports the Kefauver Committee, Ford announced its suggested price list for the 1957 models. The average price increase was 2.9 per cent and, according to a Ford representative, was "no more than our actual costs for labor and materials have gone up." Two weeks later, General Motors announced its prices on the new Chevrolet, reflecting an average increase of 6.1 per cent over the previous year. Ford waited one week, and then revised its prices upward. In addition, it reduced the dealer discount from 25 to 24 per cent, "making it the same as Chevrolet's." The net effect was that, on comparable six-cylinder models. For in six instances was only $1 below Chevrolet; in three instances, it was $1 above; in two instances, the price was identical; and in two others, the price difference was as much as $10. Plymouth prices, in general, conformed to the traditional Chrysler pattern of being about $20 higher. (Report of Senate Subcommittee on Antitrust and Monopoly, Administered Prices: Automobiles, 85th Congress, pp. 53-54). This kind of behavior, and its implications for performance, I submit, is more adequately explained by traditional oligopoly theory than by Markham's exogenous, institutional forces.

One final observation. Markham says that "whether modern markets serve better or worse the ends of economic welfare, they presumably perform more in accordance with the public's political and economic preferences." I doubt that this is so. If it is, however, the academic economist has spent too much time apologizing for the status quo and too little on performing his educational mission.*

---

* My colleague, Bernard A. Kemp, disagrees with Markham's proposition that the structure of markets has not changed since the turn of the century in the industries which include the largest firms in the economy. The top 20 industrial firms by assets in *Fortune's List* for 1958 (July, pp. 132-133) are in six industries—Petroleum (with 9 of the firms), Automobiles (3), Steel (2), Chemicals (2), Electric (3) and Aluminum (1). In each of these industries there have either been substantial changes in the size and number of firms or substantial changes in the nature of the product. These are two of the most important structural considerations. In the first decade of the century over 80 per cent of the petroleum industry was controlled by one company—the Standard Oil Trust. It was broken into 33 companies in 1911 by government antitrust action. Four of the nine petroleum companies in *Fortune's List* were part of the

DISCUSSION: CHANGING STRUCTURE OF THE AMERICAN ECONOMY: ITS IMPLICATIONS FOR THE PERFORMANCE OF AGRICULTURAL MARKETS

NORMAN R. COLLINS
University of California, Berkeley

HARDLY a meeting is held in the agricultural community today without at least one talk on integration. Comments are heard on the state of the farmer's freedom and independence, cooperatives are saying they have been integrated all along, and certain commodity groups such as livestock wonder whether they will be next on the list. But, to say the least, the analytical base for statements about the economic issues has been meager.

Cochrane has covered well a number of issues faced in analyzing the food marketing system, although time did not permit a treatment of changes occurring in the food processing area nor an extended analysis of performance of producer bargaining cooperatives. Important changes have occurred in the structure and organization of the food market which have affected the performance of the distribution system. Opportunities have been created for further improvements in performance which can be realized after structural changes are made at other points in the system. Particular emphasis was given in this paper to the line of causation emanating from the retail level.

Cochrane and Markham both discussed the general question of the factors affecting the performance of markets. Cochrane considered the agricultural market and Markham the general industrial sector. Both concluded that since the structure of the general economy had not been significantly altered, the explanation for performance changes must be found elsewhere. Their conclusions then diverge, although they are not inconsistent. Markham concluded that performance changes in the economy at large may be attributed to nonstructural determinants, namely, changes in the institutional environment. Cochrane relates performance

---

trust; two others, Texas and Gulf, were outside the trust, but small; and Phillips Petroleum was nonexistent. In the automobile industry in the early 1900's there were many companies. General Motors was formed by consolidation in 1908, and Chrysler was formed in 1925. Both acquired other companies afterward. Now there are only three major auto companies left. In steel, United States steel has declined from approximately 55 to 30 per cent of the market for most of the products which it produces. Almost all of the many products which the two largest chemical companies produce now simply did not exist in 1900 and neither did Union Carbide. The same is true for most of the products of the electric industry. Alcoa, a virtual monopoly then, has a number of significant rivals now, primarily because of government action.

In the industries which include all the top 20 companies there have been changes in structure since 1900. Some of the markets are more concentrated, others less, but in all of them the changes in structure were drastic.

changes in agricultural marketing to structural changes, but to those peculiar to the food sector.

Some commonly used indicators of industry structure are number of firms, their size distribution, and various measures of concentration with respect to employment, assets, or production. From such measures Markham and Cochrane have concluded no striking changes in general industrial structure are indicated. Cochrane was unwilling to conclude, however, that structural features of the food industry had not changed. This point deserves reflection: is it likely that important performance changes occurring within a particular industry may often be explained by structural changes specific to that industry, changes that may not be revealed by general measures applicable to all industries combined?

This seems to be true of food marketing. It has been concluded that important, perhaps the most important, structural changes have occurred at retail. These changes are indicated, for example, by the size of store unit, the number of items carried, and the design of facilities to permit self-service shopping. But when we examine certain concentration ratios, striking changes are not evident. For example, the percentage of total grocery and combination food store sales made by the four largest firms has increased only very slightly since 1929. A strong case can be made, though, for the presence of important structural changes that have offset each other in their effects on this ratio. There have also been some important changes in the organization of the food processing industry. But, from work we are currently carrying on at the University of California, the turnover among the largest food firms over time appears to be no greater than in the general industrial sector.

I would also like to comment on the interaction of structure at one level and performance at another which is indicated by a study of food marketing. Cochrane's comments indicate that performance possibilities have been opened up by structural changes at retail. It became possible to reduce costs while giving the consumer a wider range of product offerings as well as an improvement in their quality. The modern food retailer, however, maintains high sales levels by having continuously available those products that have gained substantial consumer acceptance. Large-scale retailing, as now practiced in this country, could not function effectively if it were not backed up by a highly streamlined supply organization. In order to realize these performance potentialities, rather sharp adjustments proved necessary in the procedures and methods of operation employed by firms supplying retailers.

Agricultural marketing encompasses a whole chain of activities performed to bring farm products to their ultimate consumers. The responsibilities for performing the many tasks involved are divided among a

large number of different firms. Although these businesses are organized as separate enterprises, there are, nevertheless, underlying technological relationships existing between their input-output functions. In agricultural marketing, as in many other industrial fields, the directive role of price has diminished as other procedures for coordinating the activities of different firms have grown in importance.

Firms often do not adjust their operations to those of others through a series of transactions on an open market. Nor is there necessarily complete integration based on ownership. Instead, there are varying degrees of incomplete integration. Coordination is effected through a variety of administrative arrangements whereby a number of firms agree to make jointly certain decisions affecting the welfare of all. Cochrane has emphasized the increasing role played by this type of integration. As economists we should be interested in theoretical developments necessary to understand and analyze the causes, forms, and degree of such types of interfirm arrangements. It seems that one of the most striking changes in the performance of agricultural markets is related to the improved methods now employed, represented by various integrated relationships, to coordinate activities of firms at different functional levels.

Yet, these are precisely the changes that cannot be reflected in the common measures of industry structure, since they do not affect the firm as a legal entity. Thus, the number of firms, size distribution, measures of concentration, etc., may show no change, yet the operations of firms may be coordinated just as effectively as if the number of firms were altered.

Cochrane's presentation serves very well as a general statement of the structural changes occurring at retail and their impact upon other firms in the agricultural marketing system. We should realize though, and I am sure that Cochrane will agree, that our analysis is far from being specific enough to handle many of the questions that are being raised by producer groups. We know too little, for example, of the factors which affect the type of product desired by retailers. We say generally that they need a uniform product, but what exactly is wanted in the case of eggs, meats, oranges, and canned goods? Cochrane says that a retail chain may have substantial market power. We may believe we have a good notion of what is meant by this, but are we going to be able to define this concept of power well enough to ascertain its effects on the allocation of decision-making responsibilities? And the most difficult question and the one most often raised is the effect on prices. Even though it may be granted that a higher degree of integration may facilitate more effective coordination and permit lower total costs in supplying goods and services to the consumers, what is the effect on the income of each participating firm?

Economists in the agricultural marketing area are only now coming to realize that the relationship of structural changes, perhaps in the general industrial economy and certainly in the food sector, to the performance of our agricultural markets must be carefully specified in order to comment meaningfully on the questions raised by farm groups, particularly concerning the adjustments they should make in their operations. Clodius recently argued that research should be oriented along such lines. The papers presented in this section hopefully will encourage reformulation of much of the current inquiry.

DISCUSSION: SOME MARKET STRUCTURE CONSIDERATIONS IN ECONOMIC DEVELOPMENT

HARRY C. TRELOGAN
Agricultural Marketing Service

FOR those who delve beneath the surface aspects of differences between our own and less well-developed economies, the parallels can be quite as impressive as the differences. Mueller put his finger on a good illustration by calling attention to the use of credit as a means of achieving integration of farmers into a wholesaling or processing business, and as a means of attaining monopolistic advantages. The man with the capital resources to extend credit is best able to introduce changes in structure and organization. This does not necessarily mean, as Mueller implies, that the middlemen are the first to sense economic opportunity through superior perception. It means, rather, that they are best able to grasp opportunities once they have sensed them.

The parallelism might be carried a step further to point out that marketing is a costly process in a developed nation, too. Think of the $10 billion annual cost of advertising when the state of consumer knowledge is imperfect in a highly enlightened population. By the most conservative method of estimation 60 per cent of the consumer's food dollar goes to pay for marketing services in this country. Specialization depends so much on ability to sell that integration can be explained as a means to assure market outlets. The concept of agribusiness of Davis and Goldberg[1] suggests that specialization in farming with the further removal of productive functions to off-farm enterprises has a long way yet to go.

Review of these papers convinces me that we need more study of the force of specialization on market structure and economic development. Specialization and integration develop independently; and greater produc-

[1] John H. Davis, and Ray A. Goldberg, "A Concept of Agribusiness," Graduate School of Business Administration, Harvard University, 1957.

tivity from specialization can be obtained with or without integration of firms, but the environment created by market structure may be conducive to specialization in greater or less degree.

A number of studies are underway in agricultural marketing that offer possibilities of reducing the abstractions involved in dealing with aggregates in studies of economic growth. They treat such relevant facets of market organization as methods of exchange, market news reporting and price formation, and factors influencing business decisions in particular market situations. It is hoped that these types of rather fragmentary studies may alleviate the pragmatic difficulties Mueller cites in the generalized analyses. They sorely need the benefit of the generalized approach, however, to draw the parts together into a consistent whole. Because of the complementary relationships involved, I am thoroughly in accord with Mueller's purpose of stimulating more research on economic development analysis giving due attention to market structure considerations.

Upon becoming so enamored with the parallels brought to mind by Mueller's review of observations in underdeveloped countries, it was a bit startling to note the contrast expressed in his statement that manufacturing industries are more concentrated outside the United States. Just shortly before, I had read the following statements by Berle.[2] "Today approximately fifty per cent of American manufacturing—that is, everything other than financial and transportation—is held by about 150 corporations, if we reckon by asset values. If finance and transportation are included, the percentage increases. If a rather larger group is taken, the statistics would probably show that about two-thirds of the economically productive assets of the United States, excluding agriculture, are owned by a group of not more than five hundred corporations. Five hundred corporations may control two-thirds of the nonfarm economy, but within that five hundred a still smaller group has the ultimate decision-making power. This is, I think, the highest concentration of economic power in recorded history.

"Many of these giant corporations have budgets, and some of them have payrolls, which, if their customers are included, affect a greater number of people than do many of the ninety-odd sovereign countries of the world. American Telephone and Telegraph, for example, would be somewhere around the thirteenth state of the Union in terms of budget. Some of these corporations are units that can be thought of only in somewhat the way we have heretofore thought of nations."

Markham takes cognizance of Berle's ideas but seems to lean toward

[2] A. A. Berle, Jr., "Whose Socialism?—A Story of Pots and Kettles," *The Reporter*, August 30, 1958.

Mueller's view. I am persuaded that there must be something to Berle's observation in light of the neat tricks or economic phenomena we witnessed this past year or two wherein nonagricultural prices moved steadily upward while gross national product, employment, and demand indicators, other than population, were declining substantially. Surely this took concentrated effort.

Furthermore, it is difficult for me to perceive how the theory of games or any other analytical tool could be convincing that this was a game of positive numbers played by business leaders in a highly developed country. With Markham's proposition that a point is reached where behavior is different, I agree, on the grounds that it has been manifestly demonstrated. Also, competition is turning out to be quite a departure from what might be expected under pure competition or from classical economics. Perhaps the comparison of degree of concentration deserves further inquiry.

There are indeed many market structure considerations to be taken into account in economic development. In this connection one incidental observation by Mueller struck a responsive chord. I quote: "The introduction of such fundamental things as adequate grading systems, weights and measures, price information, and laws spelling out the rights and obligations of contract, will eliminate many of the monopolistically competitive features of these markets." This observation could be extended to point out that improvement in these fundamentals would be very helpful in our economy; also that no highly developed nation has within living memory exhibited courage comparable with that of India, which has undertaken to decimalize its monetary system. Some far less pretentious improvements could be introduced here to facilitate competition, efficiency of marketing, and economic growth. Our weights and measures could stand critical review in this regard.

The point that American business managers behave differently abroad because the market structures are so different suggested another parallel. Because the scientific structure is also underdevelopd, an authoritative scientist in one subject may be accepted as authoritative in others in which his views would not be countenanced at home. Away from home he may yield to the temptation to voice his ideas in far ranging scientific disciplines. If research on economic growth should do nothing more than equip our growing delegation of scientific emmissaries with a better awareness of the potential economic consequences of some of their objectives in promoting technological advancement without giving adequate considerations to other significant factors in the economies, it would be well worth the effort. Similarily, economists should give greater credence to the views of other scientists regarding the influence of cultural and social patterns on market structure and behavior.

BOOKS RECEIVED

Barclay, George W., "Techniques of Population Analysis," New York: John Wiley and Sons, Inc., 1958. Pp. xiii, 311. $4.75.

Emphasis is placed on the techniques of demographic research and on the logic underlying them. The methods are illustrated by numerous examples, and a chapter on bibliographical material provides additional background. The topics covered include the mortality, fertility, growth, migration and employment of population.

Bassie, V. Lewis, "Economic Forecasting," New York: McGraw-Hill Book Co., Inc., 1958. Pp. ix, 702. $8.75.

Bhattacharjee, J. P. (Ed.), "Studies in Indian Agricultural Economics," Bombay: The Indian Society of Agricultural Economics, 1958. Pp. vii, 326. RS. 1800.

"The volume seeks to present studies of output, prices, trade and marketing, term of trade, employment, food consumption, investment and finance in India's agriculture, along with an introductory assessment of the progress of agricultural economic research in the country and a perspective evaluation of the changing institutional framework underlying the rural economy."

Bouvier, Charles, "La Collectivisation de l'Agriculture," Paris: Armand Colin, 1958. Pp. 242. $3.25. (U. S. Supply Source: The Mail Order Library, New York.)

Chalfant, William B., "Primer of Free Government," New York: Philosophical Library, Inc., 1959. Pp. 160. $3.00.

Cox, Oliver C., "Foundations of Capitalism," New York: Philosophical Library, Inc., 1959. Pp. 500. $7.50.

Dacca University Socio-Economic Survey Board, "The Survey of Rural Credit and Rural Unemployment in East Pakistan, 1956," East Pakistan: Pakistan Co-operative Book Society, Ltd., 1958. Pp. x, 205. Rs 7-8-0.

Denman, D. R., J. F. Q. Switzer and O. H. M. Sawyer, "Bibliography of Rural Land Economy and Landownership, 1900-1957," Cambridge: Cambridge University, 1958. Pp. 412. 35/-net.

"A full list of works relating to the British Isles and selected works from the United States and Western Europe. . . . The scope of the bibliography is exclusively rural. . . . The centre of interest is Britain and it has been the aim to include all books, articles, memoranda and periodicals, published in Britain from 1900-1956, and unpublished theses for higher degrees and reports on the library shelves of certain universities. . . . References to works published in the United States have been confined to books and articles on general themes, but are

not exclusive of works whose illustrations take on local colours."

Major classifications are: History (used as prefix); General Works; Rural Economy; Land Economy; Estate Economy; Research and Education; Reference Works; and Foreign Works (Danish, French, German, Dutch and Italian).

Desai, A. R., "Rural Sociology in India," Bombay: The Indian Society of Agricultural Economics, 1959. Pp. xviii, 440. Rs. 20/-.

Gass, Paul I., "Linear Programming: Methods and Application," New York: McGraw-Hill Book Co., Inc., 1958. Pp. 223. $5.00.

The theoretical, computational and applied aspects of linear programming. This coverage is supplemented by numerical examples and most of the mathematics needed is developed in the text. Exercises are included after each chapter.

Goldberg, Samuel, "Introduction to Difference Equations," New York: John Wiley and Sons, Inc., 1958. Pp. xii, 260. $6.75.

An elementary but vigorous introduction to the principles and application of finite differences and difference equations. Many illustrative examples suggest the alternative ways difference equations may be employed in the social sciences. The essentials of introductory algebra and trigonometry are sufficient prerequisites for the mathematical techniques used in this book.

Henderson, James M. and Richard E. Quandt, "Micro-economic Theory," New York: McGraw-Hill Book Co., Inc., 1958. Pp. xii, 291. $7.50.

Hirschman, H. O., "The Strategy of Economic Development," New Haven: Yale University Press, 1958. Pp. xiii, 217. $4.50.

Hohn, Franz E., "Elementary Matrix Algebra," New York: The Macmillan Co., 1958. Pp. xi, 305. No price listed.

"This book presents the most essential material as simply as possible and in a logical order with the objective of preparing the reader to study intelligently the applications of matrices in his special field. The topics are separated so far as possible into distinct, self-contained chapters in order to make the book more useful as a reference volume.... Since the definition of fields, groups, and vector spaces as well as of other abstract concepts appear and are used here, I believe that a course of this kind is not only far more practical but is also better preparation for later work in abstract algebra than is the traditional course in the theory of equations."

Chapter headings are: Introduction to Matrix Algebra; Determinants; The Inverse of a Matrix; Rank and Equivalence; Linear Equations and

Linear Dependence; Vector Spaces and Linear Transformations; Unitary and Orthogonal Transformations; The Characteristic Equation of a Matrix; Bilinear, Quadratic, and Hermitian Forms; and Appendices on The Notations Σ and Π, The Algebra of Complex Numbers, and The General Concept of Isomorphism.

Jarrett, Henry (Ed.), "Perspectives on Conservation: Essays on America's Natural Resources," Baltimore: Johns Hopkins Press, 1958. Pp. xii, 260. $5.00.

Johnston, Bruce F., "The Staple Food Economies of Western Tropical Africa," Stanford: The Food Research Institute, 1958. Pp. xi, 305. $6.00.

Lively, Charles E. and Jack J. Preiss, "Conservation Education in American Colleges," New York: The Ronald Press Co., 1957. Pp. ix, 267. No price listed.

The book presents results of a recent survey of teachers of courses in conservation in American colleges and universities; some general recommendations for action include: (1) encouragement of the inclusion of conservation in curricula of privately supported colleges, (2) creation of teaching aids and more appropriate textual materials, and (3) training of teachers in the subject.

Mason, Edward S., "Economic Planning in Underdeveloped Areas," New York: Fordham University Press, 1958. Pp. xi, 87. $2.50.

May, Stacy and Galo Plaza, "The United Fruit Company in Latin America," Washington: National Planning Association, 1958. Pp, xv, 316. $4.50, cloth; $2.00, paper.

Quenouille, M. H., "The Analysis of Multiple Time-Series," New York: Hafner Publishing Co., 1957. Pp. 105. $4.75.

Shoemaker, James S. and Benjamin J. E. Teskey, "Tree Fruit Production," New York: John Wiley and Sons, Inc., 1959. Pp. vii, 456. $6.95.

Slick, Tom, "Permanent Peace," New Jersey: Prentice-Hall, Inc., 1958. Pp. x, 181. $2.95.

Studenski, Paul, "The Income of Nations, Theory, Measurement, and Analysis: Past and Present," New York: New York University Press, 1958. Pp. xxii, 554. $25.00.

Tobata, Seiichi, "An Introduction to Agriculture of Japan," Tokyo: Agriculture, Forestry, and Fisheries Productivity Conference (Maruzen Co., Ltd.), 1958. Pp. 74. No price listed.

Warner, Aaron W. and Victor R. Fuchs, "Concepts and Cases in Economic Analysis," New York: Harcourt, Brace and Co., 1957. Pp. xv, 288. $2.75.

BULLETINS RECEIVED

Fallding, Harold, "Precept and Practice on North Coast Dairy Farms," University of Sydney, Department of Agricultural Economics, Research Bul. No. 2, 1958.

Hammett, Ruth A. and J. Homer Blackstone, "Household Use of Eggs in Gadsden, Alabama," Albama Agr. Expt. Sta., Bul. 311, May 1958.

Harris, B. W., J. W. Fortenberry and Richard Lyles, "Improving Livestock Marketing Practices of Negro Farm Operators, Brown Loam Area, Mississippi," Alcorn Agricultural and Mechanical College, Department of Agricultural Economics in cooperation with AMS, MRD, USDA (no number listed), June 1958.

Heneberry, William H. and Raleigh Barlowe, "Property Tax Trends Affecting Michigan Farmers," Michigan Agr. Expt. Sta. in cooperation with FERD, ARS, USDA, Special Bul. 421, 1958.

Jenkins, Sidney L., Gerald E. Marousek, and Nellis A. Briscoe, "Livestock Marketing Practices and Preferences in Northeastern Oklahoma, 1957," Oklahoma Agr. Expt. Sta., in cooperation with Oklahoma State Board of Agriculture, Processed Series P-307, November 1958.

Krause, Stanley F., "Seasonal Milk Pricing Plans," Farmer Cooperative Service, USDA, Bul. 12, November 1958.

Rhodes, V. James, H. D. Naumann, Elmer R. Kiehl, D. E. Brady and Ruth H. Cook, "A New Approach to Measuring Consumer Acceptability of Beef," Missouri Agr. Expt. Sta., Research Bul. 677, September 1958.

Rhodes, V. James, Max F. Jordan, H. D. Naumann, Elmer R. Kiehl and Margaret Mangel, "The Effect of Continued Testing Upon Consumer Evaluation of Beef Loin Steaks," Missouri Agr. Expt. Sta., Research Bul. 676, September 1958.

Savage, Zach, "Twenty-Five Years of Citrus Costs and Returns in Florida, 1931-1956," Florida Agr. Ext. Serv., in cooperation with County Agents of Citrus Producing Counties, Agr. Ext. Serv. Econ. Series 58-6, December 1958.

Schruben, Leonard W., "Changes in Winter Wheat Crop Prospects in the United States During a Growing Season as Measured by Official Production Estimates," Kansas Agr. Expt. Sta., Tech. Bul. 95, July 1958.

Thompson, William H., "Transportation of Poultry and Poultry Products, From the North Central States," South Dakota Agr. Expt. Sta., Bul. 472, October 1958.

Trotter, Warren K., "Distribution of Fertilizer by Cooperatives in the South," Farmer Cooperative Service, USDA, FCS Bul. 11, October, 1958.

Tweeten, Luther G., W. B. Back, and Kenneth R. Tefertiller, "Cost and Returns in Broomcorn and Alternative Crop Production, Southcentral Oklahoma," Oklahoma Agr. Expt. Sta., Processed Series P-308, November 1958.

PERIODICALS RECEIVED

Agricultural Economics Research, Vol. XI, No. 1, January 1959, AMS, ARS, USDA, U. S. Government Printing Office, Washington 25, D.C.

Araneta Journal of Agriculture, Vol. V, No. 3, July-September 1958, Araneta Institute of Agriculture, Rizal, Philippines.

Comercio Internacional, Ano VII, No. 12, Julho de 1958, Banco do Brasil, Rio de Janeiro.

The Indian Journal of Agricultural Economics, Vol. XIII, No. 3, July-September 1958, The Indian Society of Agricultural Economics, 46-48, Explanade Masions, Mahatma Gandhi Road, Bombay 1.

Oklahoma Current Farm Economics, Vol. 31, No. 5, October 1958, Oklahoma State University, Department of Agricultural Economics and Extension Economists, Stillwater, Oklahoma.

Ibid., Volume 31, No. 6, December 1958.

MISCELLANEOUS PUBLICATIONS RECEIVED

"Acquiring and Transferring Farm Real Estate in Kansas," Wilfred H. Pine and James K. Logan, Kansas Agr. Expt. Sta,, Manhattan, Kansas, Circular 367, November 1958.

"Agricultural Economics in Yugoslavia," J. O. Jones, University of Oxford, Institute of Agrarian Affairs, 3 Magpie Lane, Oxford, England, 1958.

"Alabama's Changing Peach Industry," Melvin W. Smith and M. J. Danner, Alabama Expt. Sta. and Alabama Polytechnic Institute, Circular 124, April 1958.

"An Economic Study of Pasture Improvement on Some Farms in New South Wales," Keith O. Campbell and Richard T. Shand, The University of Sydney, Dept. of Agr. Econ., Sydney, Australia, Mimeographed Report No. 2, 1958.

"El Proceso Presupuestario Fiscal Chileno," Alban Lataste, Instituto de Economia, Universidad de Chile, Santiago, Chile, Mimeographed, 1958.

"1933-1958 Farmers Build Their Own Production Credit System—Organization and First 25 Years," C. R. Arnold, Farm Credit Administration, Washington 25, D.C., Circular E-45, August 1958.

"Fruit and Vegetable Bargaining Cooperatives," Wendell M. McMillan, Farmer Cooperative Service, USDA, Washington 25, D.C., FCS Circular 25, November 1958.

"How Cooperatives Use Credit Agencies to Meet Patron's Needs," J. M. Bailey, A. H. Pursell, and R. E. Engberg, FCS, USDA, Washington 25, D.C., General Report 52, December 1958.

"Improved Farm Rental Method for South Dakota," Russell L. Berry, South Dakota Agr. Expt. Sta., Brookings, South Dakota, Circular 141, June 1958.

"Institutional Aspects of Federal Government Marketing of Dairy Products," William G. Tomek and Ernest Feder, University of Nebraska, Dept. of Agr. Econ., Lincoln, Nebraska, Progress Report No. 12, December 1957.

"Inventory Management by Selected Retail Farm Supply Co-ops (Area II—Washington, Oregon, Idaho, Utah)," John M. Bailey, Farmer Cooperative Service, USDA, Washington 25, D.C., Service Report 37, July 1958.

"Marketing Fresh Apple Juice and Cider," Dana G. Dalrymple, University of Connecticut, Dept. of Agr. Econ. and Farm Mgmt., Storrs, Conn., Progress Report 27, November 1958.

"Report to the National Farm Loan Associations for the Year Ended June 30, 1958," National Farm Loan Association, Farm Credit Administration, Washington 25, D.C., 1958.

"Rural Population Movements in Relation to Economic Development," Keith O. Campbell, University of Sydney, Sydney, Australia, Agr. Econ. Res. Misc. Paper No. 15 (no date listed).

"What Can I Pay for Feeder Pigs?" Morris White and J. H. Yeager, Alabama Expt. Sta. and Alabama Polytechnic Institute, Auburn, Alabama, Leaflet No. 57, September 1958.

REVIEWS

Produktionsgestaltung und Betriebsgrosse in der Landwirtschaft unter dem Einfluss der wirtschaftlich–technischen Entwicklung, Dr. Hans-Heinrich Herlemann and Dr. Hans Stamer, Kiel: Institut fuer Weltwirtschaft an der Universitaet Kiel, 1958. Pp. vi, 147. DM 14.

The existence of differences in the combination of land, labor, and capital on farms in various parts of the world is well-known even if the reasons behind these differences are not always clearly understood. The authors recognize this fact and set themselves the ambitious goal to supply the missing information. Their analysis comes in two parts—the theoretical "model" followed by the empirical "verification."

The first section is a restatement of the general equilibrium equation demonstrated with the aid of a so-called "factor triangle." Any point within this triangle (and there is an infinite number of them) represents a particular combination of the three factors—land, labor, and capital. The device is used to suggest factor combinations prevalent for different countries but mainly to get away from "complicated" mathematics. Its disadvantage is that it shows neither the output corresponding to a given combination of factor inputs nor the marginal rate of substitution existing between production factors; in fact, the triangle as it is presented implies constant rate of substitution between factor inputs.

In the section following, the authors argue that differences in factor combination existing on farms in various parts of the world are merely a manifestation of different steps in a unique process of development involving the agricultural firm in all industrial countries. To demonstrate this they describe typical farm organizations as they existed at the time of the industrial revolution (the date of which differs, of course, from country to country) and try to trace changes which have occurred since that time. Two characteristic types of development paths are suggested, one followed by the agricultural firm in countries with large populations per unit of land area at the time of the industrial revolution (that is, Europe), the second path relevant mostly for overseas areas which started with small populations per unit of land area (that is, United States, Canada, and Australia).

The following steps characterize this development process: in countries with large populations per unit of land area at the time of the industrial revolution, the first step is an increase in the use of labor per unit of land area (condensation); next, as more capital is generated in the economy, more of it is used in agriculture mainly for purposes of increasing per-acre yields (intensification); and as a result of increasing labor prices, capital in the form of laborsaving machinery begins to be sub-

stituted for labor (mechanization) to be followed by the fourth step—increases in the farm size.

In countries starting with small populations per unit of land area, such as the United States, Canada, and Australia, the process works in the opposite direction and has only three steps. First, too much land is made accessible which means that large chunks of it lie idle and only gradually more land is brought into use; next, mechanization takes place; and, finally, the intensification stage is reached (increased per-acre yield, etc.).

According to the authors, the only driving force behind these patterns of development is the changing price relation between the three production factors—land, labor, and capital. These relative factor prices are undoubtedly partly responsible for particular factor combinations, and so the suggested scheme has *some* intuitive appeal. Since it fails to recognize institutional factors (that is, religious and cultural environment, inheritance customs, Homestead act, etc.) as explanatory variables, it can not treat the relationship between relative prices, institutional environment, and the rate of technological change and consequently tells only a relatively small part of the whole story. The authors admit this, quite late in the book, after a long "empirical" struggle with relative costs (page 109).

The second part of the book opens with a very instructive description of the major climatic zones of the world with reference to their agricultural use potential. This section will be useful for research workers interested in economic development or those concerned with technical and financial assistance to economically less developed countries.

The main part of the empirical section, however, is taken up with a comparison of farm organizations in different areas of the world. Since data for entire countries are either not available or not detailed enough to be useful, the authors limit themselves to an analysis of farm record data for roughly comparable farms in northern Germany, southern Sweden, Switzerland, the United Kingdom, and the United States. The United States' farms are located in northern New York state, northwestern Illinois, southern Wisconsin, and northeastern Iowa. Unfortunately, this part of the analysis turns out to be little more than a comparison of labor productivity of a selected group of farms in Germany and the United States. The general equilibrium model proposed in the beginning of the book as the guiding principle for the empirical analysis is abandoned and replaced by "Blohm's fully mechanized farm," an arbitrary standard reminiscent of those used in "thermometer chart" analysis, popular among some farm management extension workers in the United States. One might add here that it is probably just as well that the authors did not carry out their original intention to apply the general equilibrium equation to their empirical analysis. Had they done so, some of their own data should have made them wonder if the degree of "equilibrium"within an economy is at

all relevant as a standard on which to base comparisons between countries. From the data on page 103, for example, one can compute the ratio between hourly industrial wages and hourly farm wages to be 2.2 for the United States, 1.96 for Canada, 1.64 for Germany, and 1.25 for Greece. Although not all the countries listed in this table fall as neatly in line as the ones listed, they nevertheless suggest the possibility that agriculture in countries with high per-capita incomes might be much more out of equilibrium than is true for countries where per-capita income is low.

From the viewpoint of methodology, the comparison of farm organizations between countries as carried out by the authors raises some interesting questions. First of all, it is doubtful that they should be made on a monetary basis using current exchange rates. American farm income, expenses, or investments, for example, are grossly overvalued when they are expressed in German marks at the rate of $1.00 = DM 4.20. This exchange rate misrepresents the actual comparative purchasing power of these units. There are other factors implied in a monetary comparison which tend to bias the size of capital investment on American farms in the opposite direction—for example, the rapid depreciation rate which is used in this country. Many more similar factors could be listed; they all suggest, however, that if international comparisons of this kind can be made at all they should be made in terms of physical units—that is, tractor horsepower, number of plows, combines, etc.

The hypothesis of Part I, in spite of some of its shortcomings, is by far the most valuable part of this book. If institutional factors and the intricate relationship between relative price changes, institutions, and the rate of technological change can be worked into this hypothesis more fully, it will represent a useful contribution to the theory of economic development.

CHRISTOPH BERINGER

Universiy of California

Farm Size and Output Research, A Study in Research Methods, Southern Cooperative Series Bulletin 56, June 1958.

In *The Atlantic Monthly,* October 1958, Oliver LaFarge reports that in Central America, the long extinct Mayas "in their heyday held interstate conferences of learned men and unified their calculations, astronomy, and written forms across hundreds of miles of territory. . . ." Thus we see that regional research conferences are hardly novel. We conjecture further that then as now an important yield of such conferences was methodological rather than substantive. Yet so subtle is the study of methodology in research that it is, perhaps, best attempted in pursuance of specific substantive objectives.

Farm Size and Output Research reports methodological alternatives

considered by the Southern Farm Management Research committee in studying the following problem areas: "(1) minimum resource requirements to achieve a given income level in selected areas in the south, (2) product-supply relationships of various, important southern commodities, and (3) adjustments to changing price structures in the southern region" (preface).

Among methods considered, programming was the specific concern of W. D. Touissant ("Programmming Optimum Firm Product Supply Functions") and Earl R. Swanson ("Programming Optimal Farm Plans"). It was also more or less the concern of Ralph G. Kline (Selecting Input-Output Data") and R. J. Hildreth ("Selecting Price Data") though data satisfying requirements of programming might also satisfy requirements of analytical techniques we now may refer to as "other." James F. Thompson was assigned the difficult topic of "Defining Typical Resource Situations," so important to implementing empirically the supply aggregates conceptualized by James S. Plaxico in "Aggregation of Supply Concepts and Firm Supply Functions."

Problem area (1) was met alone by John M. Brewster in "Analyzing Minimum Resource Requirements for Specified Income Levels," wherein he offers an example of budgeting as a technique relevant to this problem. The conference report is completed with a paper by Fred H. Wiegmann on "Application of Results for Policy Evaluation" and a commentary by Glenn L. Johnson who served as consultant for the conference. For each paper at least one discussant was assigned. Contributions of discussants comprise an important part of the bulletin.

Area (3) was largely ignored in both methodology and substance, aside from some implications found in or that might be read into the articles from Touissant and Plaxico. Moreover, such "adjustments" as are found are limited there to intrafarm adjustments associated with supply-response.

The prospective reader is well advised to heed the subtitle. The report (and, hence, this review) deals primarily with methods not results of research. Such empiric content as is present serves only to illustrate methods. Though most (not all) of these examples are drawn from southern agriculture, the methods considered in the conference are not limited to southern agricultural problems. A (minor) complaint might relate to the lack of a systematic review of research literature available in general and in the south particularly, that bears on the problem areas that formed the substantive focus of the conference. Such a review might have been redundant for the conferees. I suspect it would have been helpful to the reader—especially if coupled with a more adequate statement of specific problems for which the conference was formed. One is left to wonder a bit about the context of some of the papers, being unaware of preceding deliberations of the research group.

Actually, this is a small matter relative to most of the papers since each rests mainly on its own independent merits. The single exception (as mentioned by its discussant) is in the article on "Defining Typical Resource Situations." Many will feel, as does the reviewer, that the substantive importance of future regional research depends heavily on the development of methods appropriate to forming estimates of economically significant quantities aggregated over a range of conditions defined in terms that are observable and manageable with known quantitative research methods.

Swanson's lucid statement on research limits imposed by linear programming assumptions is matched by Touissant's demonstration on deriving supply relations by price-mapping with the use of an optimal linear program. With Kline's outline of data sources for estimates of production coefficients, these papers make an important contribution to the rapidly growing body of literature relating to applications of linear programming techniques in agricultural problems. It may seem a bit curious to the reader that programmming techniques apparently were not considered by the conferees for problem area (1) (resource minima for specified income levels). It would seem that, conceptually, they might be fully as appropriate for this kind of problem as for the problem of estimating supply-response.

Actually, the derivation of supply response estimates by programming (and various price-mapping variants) yields always some sort of "optimal response," in terms of the criterion relation and structural activities that represent organizational alternatives. This point is clearly recognized by Touissant and others. Yet this kind of estimate falls short (in unknown directions and by unknown amounts) of a supply relation that describes what producers might actually do in response to change in relevant prices. Besides the important possibility of nonoptomizing behavior on the part of agricultural producers, several issues unraveled by Plaxico will tax the ingenuity of the would-be programmer in estimating supply responses. Though other techniques have yet to show much promise in yielding useful estimates of aggregate supply response estimates, it might have been useful to have reviewed and compared them. Perhaps (and this seems likely to the reviewer) a combination of analytical techniques is needed to estimate aggregate supply-responses.

One can predict that several of these papers will be fed to a wide array of agricultural economics graduate students in courses on research methods and production economics. The general level of technical quality is high, though perhaps a bit varied. Beyond this function, the bulletin illustrates the usefulness of mapping the terrain of a problem area before launching large scale regional research.

C. B. BAKER

University of Illinois

considered by the Southern Farm Management Research committee in studying the following problem areas: "(1) minimum resource requirements to achieve a given income level in selected areas in the south, (2) product-supply relationships of various, important southern commodities, and (3) adjustments to changing price structures in the southern region" (preface).

Among methods considered, programming was the specific concern of W. D. Touissant ("Programmming Optimum Firm Product Supply Functions") and Earl R. Swanson ("Programming Optimal Farm Plans"). It was also more or less the concern of Ralph G. Kline (Selecting Input-Output Data") and R. J. Hildreth ("Selecting Price Data") though data satisfying requirements of programming might also satisfy requirements of analytical techniques we now may refer to as "other." James F. Thompson was assigned the difficult topic of "Defining Typical Resource Situations," so important to implementing empirically the supply aggregates conceptualized by James S. Plaxico in "Aggregation of Supply Concepts and Firm Supply Functions."

Problem area (1) was met alone by John M. Brewster in "Analyzing Minimum Resource Requirements for Specified Income Levels," wherein he offers an example of budgeting as a technique relevant to this problem. The conference report is completed with a paper by Fred H. Wiegmann on "Application of Results for Policy Evaluation" and a commentary by Glenn L. Johnson who served as consultant for the conference. For each paper at least one discussant was assigned. Contributions of discussants comprise an important part of the bulletin.

Area (3) was largely ignored in both methodology and substance, aside from some implications found in or that might be read into the articles from Touissant and Plaxico. Moreover, such "adjustments" as are found are limited there to intrafarm adjustments associated with supply-response.

The prospective reader is well advised to heed the subtitle. The report (and, hence, this review) deals primarily with methods not results of research. Such empiric content as is present serves only to illustrate methods. Though most (not all) of these examples are drawn from southern agriculture, the methods considered in the conference are not limited to southern agricultural problems. A (minor) complaint might relate to the lack of a systematic review of research literature available in general and in the south particularly, that bears on the problem areas that formed the substantive focus of the conference. Such a review might have been redundant for the conferees. I suspect it would have been helpful to the reader—especially if coupled with a more adequate statement of specific problems for which the conference was formed. One is left to wonder a bit about the context of some of the papers, being unaware of preceding deliberations of the research group.

Actually, this is a small matter relative to most of the papers since each rests mainly on its own independent merits. The single exception (as mentioned by its discussant) is in the article on "Defining Typical Resource Situations." Many will feel, as does the reviewer, that the substantive importance of future regional research depends heavily on the development of methods appropriate to forming estimates of economically significant quantities aggregated over a range of conditions defined in terms that are observable and manageable with known quantitative research methods.

Swanson's lucid statement on research limits imposed by linear programming assumptions is matched by Touissant's demonstration on deriving supply relations by price-mapping with the use of an optimal linear program. With Kline's outline of data sources for estimates of production coefficients, these papers make an important contribution to the rapidly growing body of literature relating to applications of linear programming techniques in agricultural problems. It may seem a bit curious to the reader that programmming techniques apparently were not considered by the conferees for problem area (1) (resource minima for specified income levels). It would seem that, conceptually, they might be fully as appropriate for this kind of problem as for the problem of estimating supply-response.

Actually, the derivation of supply response estimates by programming (and various price-mapping variants) yields always some sort of "optimal response," in terms of the criterion relation and structural activities that represent organizational alternatives. This point is clearly recognized by Touissant and others. Yet this kind of estimate falls short (in unknown directions and by unknown amounts) of a supply relation that describes what producers might actually do in response to change in relevant prices. Besides the important possibility of nonoptomizing behavior on the part of agricultural producers, several issues unraveled by Plaxico will tax the ingenuity of the would-be programmer in estimating supply responses. Though other techniques have yet to show much promise in yielding useful estimates of aggregate supply response estimates, it might have been useful to have reviewed and compared them. Perhaps (and this seems likely to the reviewer) a combination of analytical techniques is needed to estimate aggregate supply-responses.

One can predict that several of these papers will be fed to a wide array of agricultural economics graduate students in courses on research methods and production economics. The general level of technical quality is high, though perhaps a bit varied. Beyond this function, the bulletin illustrates the usefulness of mapping the terrain of a problem area before launching large scale regional research.

C. B. BAKER

University of Illinois

La Collectivisation de l'Agriculture, Charles Bouvier, New York: The Mail Order Library, 1958. Pp. 246. $3.25.

Revolution Dans les Campagnes Chionoises, (Revolution in Rural China), Rene Dumont, New York: The Mail Order Library, 1957. Pp. 463. $3.50.

Preparation of Bouvier's study was sponsored by the East European section of the French National Political Science Foundation. The essay covers Soviet Russia, East European Satellites and Communist China.

Bouvier presents a broad philosophical, political and socio-economic background of farm collectivization, its practices and impact. He starts with the spark of the idea in Marx's mind and carries it through the metamorphosis of Lenin, Stalin, Mao Tse-tung, Tito. Here is fascinating chronology of ideological zigzagging about the means by which the Communists try to achieve the end—industrialization. In spite of incredible cruelty and apparent economic wastes, there is nevertheless frightful efficiency in the process.

The analysis of collectivization's role in the planned socialization of economies contains some interesting attitude studies on the psychology of peasantism, and how to deal with it. The reviewer is not aware of anything similar in English. Otherwise the Anglo-Saxon scholar will find little new in the book. However, the lay reader might find here a quick, broad over-all review of a tremendously important part of the current world political scene. The workmanship is competent; the text is somewhat wordy, but it reads well, there are few cumbersome footnotes, and hardly any statistical tables. All these qualities might warrant translation of this essay and American publication as a paperback.

Dumont concentrates his attention on the 1955-56 push for collectivization of Chinese agriculture—probably the largest planned social change in the history of mankind. It directly affected more than 400 million people.

Mao Tse-tung took a leaf from the 1929-32 experience of Soviet collectivizaton—a brutal and disastrous undertaking. The Chinese program had been prepared by gradual stages ever since the land reform of 1949-52.

Dumont's major contribution is a series of monographs on the 43 villages in 14 widely scattered provinces that he personally had a chance to visit and study. He labored under the disadvantage of interviewing a nonrandom sample of peasants via presumably less-than-objective interpreters; yet he found that statistics were easier to get locally than in Peking. Dumont concludes that Mao Tse-tung's approach to collectivization was more flexible and less ruthless than the Russian precedent. This is despite the fact that China has an over-population problem of frightening dimensions. These findings are worth noticing because they

come from a seasoned expert observer. Dumont started his professional career as public servant in French Indochina, studied the Chinese mainland during the Chiang-Kai-shek era, wrote books about American farming and the agricultural economy of the world. He is currently professor of comparative agriculture at the National Farm Institute in Paris.

As long as it remains virtually impossible for U. S. citizens to legally tour Communist China, Dumont's study will be one of the most valuable and authoritative accounts available to our scholars.

FRANK MEISSNER

Crown Zellerbach Corporation
Golden Gate College, San Francisco

Three Essays on the State of Economic Science, Tjalling C. Koopmans. New York: McGraw-Hill Book Company, Inc., 1957. Pp. xii, 231. $6.50.

This book contains an exposition of the analysis of competitive equilibrium ("Allocation of Resources and the Price System"), which comprises more than half the volume, and two essays on methodology: "The Construction of Economic Knowledge," and "The Interaction of Tools and Problems in Economics." In these essays Koopmans reveals himself to be as great a literary economist as he is a mathematical economist; few books in economics have been written with such eloquence and beauty of style.

The first essay is for the most part an exposition of the theory of competitive equilibrium, accessible up to now only to those few with the equipment necessary to follow the articles on the subject by Wald, von Neumann, Arrow, Debreu, McKenzie, and Gale. The postulates and resulting propositions are set forth with great clarity, culminating in the fundamental theorem of welfare economics—that a competitive equilibrium is a Pareto optimum, and conversely that to any Pareto optimum one can associate a corresponding competitive equilibrium. By a clever device, namely by conceiving of an economy in which there is exactly one consumer of each commodity, Koopmans shows that efficiency may be considered formally as a special kind of Pareto optimality. The postulates of Koopmans' own linear activity analysis follow from this simple translation of concepts.

This reviewer would have preferred more discussion of two rather thorny and related problems that beset the theory of competitive equilibrium. The first problem is that, unless unnecessarily restrictive assumptions (such as decreasing returns to scale) are made, the theorems only prove that an equilibrium *could* (not would) exist. That is, at equilibrium prices with constant returns to scale, while there is an optimal point for producers that is also optimal for consumers, there is nothing to guarantee that producers will pick from their optimal set a point which is a competi-

tive equilibrium. This is the old problem of the determinants of "neutral" equilibrium under constant costs. Koopmans suggests that this problem could be solved by introducing postulates concerning the communication of information between producers and consumers. One such device, it should be noted, would be a dynamic adjustment device: a nonequilibrium state could not be sustained by competitive prices, which would have to change in some way until equilibrium was achieved. Thus the question of stability of equilibrium is not just supplementary to, but is intimately bound up with, the question of the existence of equilibrium.

The second problem has to do with the characterization of the boundary of subsistence. It would seem natural to this reviewer to identify this boundary with a lowest indifference curve; such an identification would result in the avoidance of one of the awkward mathematical problems (p. 34), and would also appear more in conformity with the assumption that utility is real-valued rather than lexicographic. Most writers in this field are moreover, somewhat embarrassed by the fact that they must introduce a postulate to guarantee that productive capacity is high enough (or subsistence level low enough) to ensure equilibrium above subsistence; this appears quite close to assuming one's conclusions in advance. However, it should be recognized that if some such accident of nature had not come about, we would not be on earth to theorize about it; and that some economies *have* perished. It would be of interest to explore the consequences of the introduction of a Malthusian dynamic mechanism of adjustment, or a postulate concerning automatic redistributive methods of avoiding starvation (taking in of relatives, featherbedding, etc.).

Koopmans concludes this analysis with a statement (p. 89) that would make a suitable epigraph to grace the façade of a future Ministry of State Planning: "Efficiency implies prices, and any efficient state or program can be sustained by suitable prices." When it comes to the role of the rate of interest in the allocation of resources over time, however, Koopmans is more pessimistic. This is not surprising, since his model (based on that of Malinvaud) allows in principle for the possibility that technology could vary arbitrarily greatly from one period to the next, and that output could be produced without labor. Had he included a postulate that the production-overtime model had, as one of its possible solutions, a stationary equilibrium satisfying the postulates of the previous model, no doubt the interest rate would have been found no less basic than prices, as Lerner showed so well in the *Economics of Control* (pp. 247-8).

In the second essay Koopmans takes issue with Milton Friedman's position that any attempt to test the realism of the assumptions underlying a theory is, to use a favorite nineteenth-century English epithet, "mis-

chievous"; that in using a theory to make predictions concerning a particular class of phenomena, one should judge its validity (i.e., prognosis of the success of this class of predictions) solely by its past predictive success concerning that class of phenomena and no others. As Koopmans points out, any postulate implies itself, so Friedman's position amounts to separating the implications of a hypothesis into two classes, "relevant" ones which are subject to test, and "irrelevant" ones which are exempt from test. The trouble with this approach is that it assumes that the scientist knows in advance which facts are and are not relevant to his problem. It also seems to rest on the assumption (presumably also exempt from test) that "implications" are insensitive to changes in "assumptions"; a proposition which is certainly not true in general, and whose truth in any event can be established only be deducing the consequences of alternative assumptions. Friedman's point of view, as Koopmans observes, is a denial of the principle of generalization; it would seek one theory for each event to be predicted. If economists had theories with predictive powers remotely approaching those of the physical sciences, they could safely afford to neglect inconsistencies between "assumptions" and observations; as things are, they can ill afford to be so smug. With opportunities for experimentation as limited as they are, economists should be grateful for any evidence that sheds light on the possible success of their predictions –however indirect.

The final essay tackles critically some of the types of "assumptions" on which much of contemporary theory rests (the two-country two-commodity assumption of international trade theory, the aggregative assumptions of business-cycle theory, etc.) and suggests that in most cases the mathematical tools have dictated the assumptions rather than the assumptions dictating the tools.

This is a book which will make economists reflect deeply on their own work. Above all, it will inspire its readers with the steadfastness and scientific integrity of an economist who is never content to scratch the surface of any problem. The publishers are also to be commended for an unusually handsome job of printing, marred only by a few misprints (pp. 13n, 108, 110, 111, 215n.)

JOHN S. CHIPMAN

University of Minnesota

Analytical Tools for Studying Demand and Price Structures, Agriculture Handbook No. 146, Richard J. Foote, Washington: U. S. Government Printing Office, 1958. Pp. 217. $1.00.

This handbook is a welcome addition to the series of USDA Handbooks on technical subjects. It is an expansion and revision of Agriculture

Handbook No. 64, *Analytical Tools for Measuring Demand,* by Richard J. Foote and Karl A. Fox.

The objective "to acquaint research workers in agricultural economics with some of the recent developments in the field" is accomplished. Many readers will find this an excellent synopsis of the status of demand analysis and applied econometrics in 1958. Publications, manuscripts, and discussions of workers in the USDA are used extensively. The concepts and examples from this source make the book much more interesting and valuable. The literature cited contains 108 entries, of which somewhat more than four-fifths have dates later than 1950.

The subject matter of this handbook is applied econometrics, especially that part of econometrics dealing with market aggregates. This choice corresponds with the interests of most economists studying demand and supply relations better than do most discussions of econometrics.

Applications are stressed in most parts of the handbook. Although "some of the sections . . . presume a knowledge of college algebra, matrix algebra, and calculus" most of the material will be comprehensible to persons with very limited training in mathematics. A general knowledge of applied statistics and price analysis is a prerequisite, however. The breadth of material covered is well illustrated on pages 78 and 79 where Marshall's famous graphic method for determining the elasticity of demand is on a page facing a discussion of how to conveniently obtain from an electronic computer certain matrices needed for "limited information" estimates.

The emphasis on nonmathematical exposition may be illustrated by the experimental work to illustrate bias in econometric estimation. One may wonder whether the substitution of "the value that would be obtained from a similar calculation based on the combined evidence of all possible data" for *expected value* of a statistic is not being too nonmathematical in the interest of apparent clarity.

The conflicting arguments in favor of "simple" least-square estimation and other estimating methods are presented in detail. The extensive experience of the author and the *Agricultural Marketing Service* are used to illustrate these arguments. Among the arguments against least squares the "classical" two-variable demand and supply model is fully exploited, but extensive *Monte Carlo* Experiments are apparently regarded as the most convincing arguments. These experiments may not, as the authors say, "settle forever all arguments about the relative merits of these two approaches." One may predict, however, that they will be read by a very large number of classes, and will provide some of the best illustrative material available.

Choosing what to discuss from this handbook is difficult. I should like, however, to mention several topics that seem to be unusually well handled here.

The notion of *partially-reduced form equations* is introduced and illustrated in terms of studying derived demand elasticity in particular outlets or at various market levels. The problems of aggregation, the use (and meaning) of distributed lags, and the effects of serial correlation in the error terms are all treated with clarity. In the latter exposition those with limited mathematical training will have difficulty but they are forewarned by the authors. To make matters worse, one of the few defects of notation and typography occurs here (p. 151), when there is confusion between *m* variable components of a process with mean *m*.

Although the topic expressed in the title sounds as if *Demand* and *Price* were correlative variables, no such confusion exists in the text. The reviewer will be glad to overlook the title and the emphasis on "Diagrams Supply-Demand-Price Structures" in this very real eclectic and substantive contribution to the analysis of relations involving aggregate market data.

VINCENT I. WEST

University of Illinois

Die Marktregulierung fuer Milch und Molkereiprodukte in den Niederlanden, Dr. Hermann-Ernst Guenther, Kiel: Institute fuer Weltwirtschaft an der Universitaet Kiel, 1950. Pp. 144. DM 12.

The purpose of this book is to describe and analyze the development of market regulation and control measures for milk and dairy products in the Netherlands since World War I. The effectiveness of various measures is appraised and compared with those used in Denmark and Switzerland, two other European countries in whose economy the dairy industry plays a major role.

The analysis is carried out for four major periods: the time of the first world war, the depression, World War II, and the post-World War II period. The author shows that during all of these periods market control and support for milk and dairy products in the Netherlands is characterized by self-help measures more than by any other single factor. During World War I, for example, when the country was largely cut off from its fertilizer and grain imports, when land had to be diverted from pasture to meet urgent food needs, the dairy industry suffered more than any other branch of the country's agriculture. In order to alleviate the difficulties of dairy producers, a general fund was created which was supported not only by the Dutch government but also by the dairy manufacturing industry. Between World War I and the great depression, the market regulation of the dairy industry was carried out entirely without government intervention. Although some government intervention became necessary during the depression, it was kept at a minimum. During that period the regulation of the fluid milk market was carried out under direct financial participation of milk producers. Only the support of manufacturing milk, the major basis for Dutch dairy product exports, became the burden of the

general taxpayer. Again in 1935, determined efforts were made on the part of producers to participate directly in governmental anti-depression measures. Developments in the post-World War II period point in the same direction. For example, a newly created, cooperative dairy fund covers to the limit of its funds producers' losses before the governmental equalization fund is asked for help.

In addition to the analysis of various control and support measures, the book conveys effectively the importance which the Dutch dairy production and manufacturing industry assumes both within the agricultural and the total economy of the Netherlands. Finally, new market opportunities for Dutch diary products in Asia, Africa, and South America are investigated.

One might well wonder in reading this publication why it is important for Germany to subject a particular industry in a foreign country to such a thorough analysis. The answer is simply that, with lowered and eventually completely removed tariff barriers which are agreed upon under the new European Common Market, a technically and economically developed industry in one of the member countries will more directly affect producers of the same commodity in the remaining countries.

Within the American audience, there are two groups of people who might benefit from this book. First of all, those who are interested in the mechanics and the economic effects of various market regulation measures applicable in the dairy industry; and, secondly, those who are interested primarily in the effects of the new European Common Market on the economies of the participating countries resulting from shifts in the balance of international trade in particular commodities.

CHRISTOPH BERINGER

University of California

The Dynamics of Supply: Estimation of Farmers' Response to Price, Marc Nerlove. Baltimore, Md.: The Johns Hopkins Press, 1958. Pp. 267. $4.00, paper; $5.00, cloth.

For a brief statement of the subject matter and main conclusions of this stimulating book, I can do no better than quote the author. The thesis of the book is stated on p. 24.

"The chief difficulty in empirical work in economics, it appears to me, is that theory rarely deals with variables which can be observed. The problem to be solved is to relate the unobserved variables of a theory to variables which can actually be observed. Previous workers have too readily identified price lagged one year with the price which farmers take into account in planning their acreage. They have also neglected the possibility that observed acreage may not represent a position of complete adjustment to whatever price they have chosen to consider. The real world is dynamic; our theories are largely static or comparatively static; this book is largely devoted to the exploration

and testing of hypotheses which link the variables of a theory of supply with variables that can be directly observed."

His conclusion is that (p. 86)

"... previous neglect of dynamic considerations in the specification of relevant relations between unobserved and observed variables is largely responsible for the previous finding that farmers respond very little to prices in planning their acreage and their output. A more sophisticated approach to the problem of specification of relations between unobserved and observed variables greatly increases the measured effect of prices upon acreage, and greatly improves the explanation of changes in acreage."

He argues that the relevant price is P^*_t, people's expectations at time t of long-run normal price, and he hypothesizes that

(1) $P^*_t - P^*_{t-1} = \beta(P_{t-1} - P^*_{t-1})$.

Nerlove refers to β as the coefficient of expectation. If observed output, x_t, is a linear function of P^*_t,

(2) $x_t = a_o + a_1P^*_t + u_t$.

Observed output may be written as

(3) $x_t = b_o + b_1P_{t-1} + b_2P_{t-2} + b_3P_{t-3} + \ldots + u_t$ or as

(4) $x_t = c_o + c_1P_{t-1} + c_2x_{t-1} + v_t$.

The b_i and c_i are functions of β and a_1. An alternative to (1) and (2) consists of equations (2′) and (5), which emphasizes the distinction between short- and long-run elasticities.

(2′) $x^*_t = a_o + a_1P_{t-1} + u_t$.

(5) $x_t - x_{t-1} = \gamma\ (x^*_t - x_{t-1})$

were x^*_t is long-run equilibrium output. Nerlove refers to γ as the coefficient of adjustment. Hypotheses (2′) and (5) also lead to equation (3) or (4); the b_i and c_i being functions of γ and a_1. Thus a regression of the type (3) or (4) has a dual interpretation.

The coefficient of expectation and the coefficient of adjustment can be brought into the same model through combining (1), (2″) and (5). This procedure—

(2″) $x^*_t = a_o + a_1P^*_t + u_t$

although possessing logical appeal—encounters formidable statistical problems.

In this book, Nerlove applies the same methods to empirical supply analysis that he has previously applied to demand analysis.[1] Model (2′)

[1] Marc Nerlove, *Distributed Lags and Demand Analysis for Agricultural and Other Commodities*, Agriculture Handbook No. 141, Agricultural Marketing Service, June, 1958.

and (5) is the "technological or institutional rigidities model" of Handbook 141; (1) and (2) is the "expectation model" of Handbook 141.

The theoretical analysis of supply dynamics is presented in Chapter II. Chapter VIII presents statistical results based on equations (3) and (4); Chapter IX presents results from the model combining hypotheses (1), (2″) and (5). In these chapters, x_t is acreage. These three chapters, along with Chapter I are the heart of the book; Chapter I is a static analysis of individual firm and industry supply functions. These four chapters constitute about 40 per cent of the book.

Chapter III is a review of previous studies of the supplies of various crops. Chapter IV discusses kinds and sources of errors of measurement in the data used in the statistical analyses. On page 87 Nerlove writes, "An investigation of the nature of the data used in any statistical investigation is essential to the interpretation of the results." After devoting 25 pages to "the nature of the data" he nowhere uses this knowledge in the "interpretation of the results" in Chapters VIII or IX. Here Nerlove neatly typifies the problem facing agricultural economists. A careful analyst wants to know something about the nature of the data he has to work with. Without being able to quantify the variances and covariances of the errors of observation—as we rarely can—about all that can be done is to note that the presence of errors of observation has had some (unknown) effect on the statistical results.

An appendix to Chapter IV presents an interesting analysis of the abandonment of planted acreage. Chapters V, VI and VII take up the general characteristics of corn, cotton and wheat production, and government programs. These are the three crops for which supply equations are fitted in Chapters VIII and IX.

This book will have a significant impact on the empirical analysis of supply. For this very reason certain cautioning comments are in order.

(A) A user of these models would be well advised to follow Nerlove's precedent and include a time variable; otherwise lagged supply becomes a trend variable in the case of commodities whose supply has experienced a trend from any cause.

(B) The application of equations such as (3) or (4) to livestock products may improve predictive ability, but it is doubtful that the coefficients have any structural interpretation. Model (1) and (2) seems unsatisfactory for livestock products. It deals with the idealized situation in which current output is determined by decisions made and the expectation as to current price formed during one period. The current output of livestock products depends on decisions made in more than one period and on expectations concerning present price that were formed during several periods. Nor will model (2′) and (5) do for livestock products where the gestation and production periods cover several seasons and there are several decision

periods. Equation (2′) is too simple to be an adequate explanation of the long-run equilibrium level of output of such products. The model consisting of equations (1), (2″) and (5) may be logically satisfactory for the analysis of livestock supply.

(C) The author has exercised considerable ingenuity in his attempts to measure the effect of price upon acreage. This should not blind the supply analyst to the possibility that many factors other than price may play a role, and perhaps a more important role than price, in determining output or acreage.

Some readers of this book may wonder why Nerlove did not include livestock price in his corn acreage equations. He has previously argued that livestock prices affect the demand for corn but not its supply.[2] This overlooks the possibility that farmers may plant corn with the intention of feeding all or most of it to their own livestock. Since they view corn as an intermediate product, their acreage is affected by expected livestock prices. The results from some logarithmic corn acreage regressions I have computed give some support to this view. The only significant coefficients obtained were the positive coefficients of deflated livestock prices lagged two years or three years.

A few words about the author's selection of topics to include in the book. Just as it is the author's prerogative to include and exclude what he chooses, it is the reviewer's prerogative to comment on his choices. This book gave me the impression of being a collection of essays rather than of being a unified treatment of the subject listed in the title. Chapters IV to VIII take up one-third of the book. The material from these chapters that was used in formulating the models or interpreting the results could have been presented in a few pages. Some 20 pages of Chapter VIII apply his statistical results to forecasting accuracy, the stability of cobweb equilibrium and welfare losses under alternative price support programs. Although interesting, these materials struck me as being tangential to the author's purpose; they were certainly tangential to my interests in reading the book. Two things the author left out which I would like to have seen included are a complete presentation in Chapter VIII of the iterative method used in the estimation of equation (3) and some discussion of the application of the models to livestock products.

In summary, each part of this interesting book demonstrates care and competence. The quality of the total book, however, is not as high as the quality of the individual parts because so many pages are devoted to side issues.

GEORGE W. LADD

Iowa State College

[2] "Elasticities of Supply of Selected Agricultural Commodities," *Journal of Farm Economics*, Vol. 38, May 1956, p. 506.

Efficiency in Government Through Systems Analysis, Roland N. McKean. A RAND Corporation Research Study. New York: John Wiley and Sons, Inc., 1958. Pp. X, 386. $8.00.

All citizens are interested in maximizing the beneficial results of public expenditures. In fiscal 1954, for example, the federal government made cash outlays of $72 billion which represent about one-sixth of all the goods and services produced in the nation. Therefore, the citizens of the nation are interested in a substantial manner, in getting the most in goods and services from these expenditures.

This volume presents methods for appraising alternative courses of action (with selected examples of application of these methods) whereby citizens and their representatives may make appraisals of governmental outlays toward the end of increasing efficiency in governmental expenditures. The method presented involves "systematic quantitative analysis" in comparing alternative courses of public expenditures.

In the author's viewpoint, the volume is addressed to people "regardless of their backgrounds" who have a common interest in applied economizing. This includes, particularly, cost-benefit analysts, operations researchers, government personnel engaged in evaluating alternative courses of action, academicians engaged in teaching, research and extension and people generally concerned about economy in government.

The methods and applications presented in the volume constitute invaluable tools for use by researchers, teachers, administrators, legislators, and public and private groups interested or engaged in decision making regarding allocation of public funds. Even though few "average citizens" may take the time and effort on their own to digest the content of the book, results of its use by the above groups should enhance the understanding of and participation of citizens in the growing and vital area of public expenditures.

The volume is divided into six parts made up of 13 chapters and an 18 page appendix detailing federal expenditures by programs and specifying indicators of performance. Also, a valuable selected bibliography is included for further study on methods presented.

Part 1 introduces the study by outlining in a convincing manner the role of analytical aids in appraising alternative courses of action open to decision making persons and groups. Special attention is given to cost-benefit analysis applied in water-resources policy which currently involves outlays of $2 billion annually by the federal government alone—an outlay which may well reach $70 to $100 billion over the next generation.

Part 2 treats general problems of analysis. These problems include selection and use of criteria, selection of appropriate alternatives, intangibles and uncertainties and time flows of benefits and outlays all related to criteria.

Part 3 deals with special problems characterizing water-resource project analysis. These include the selection of projects, kinds of benefits and costs, and the matters of "spillover" effects, over-counting and secondary benefits.

Part 4 consist of two case studies illustrating the problems of analysis and exemplifying applications of suggested methods of analysis. The Green River Watershed located in Kentucky and Tennessee and the Santa Maria Watershed in California used in the case studies, represent a wide variety of problems embraced in application of the analysis. This part of the volume is an exceptionally lucid and useful application of procedures presented in earlier chapters.

Part 5 deals with other potential uses of the analysis of increasing governmental efficiencies. This part deals with (1) the analysis for performance budget accompanied by a helpful illustration and (2) analytical aids to governmental economy including a survey of opportunities.

The volume accomplishes a difficult objective of grounding theory in actual problems through real examples and illustrations. Although the methods are solid economics, they are presented in a manner intelligible and demonstrably useful to people other than specialists in economics.

The central thesis of this volume is that conventionally determined benefit-cost ratios in fact represent only a ratio between gross benefits and total costs, and, hence, only show whether the expected net returns from a public investment would be greater or less than zero. In practice it is such benefit-cost ratios that the representatives of the public often use as a criterion in allocating funds among various projects. The author contends, and properly so, that rather than the gross benefit-cost ratios, it is the comparison of incremental additions to net benefits which is usually the relevant criterion of project ranking because it reflects true comparative internal rates of return. The major portion of the volume is devoted to the task of developing, refining, appraising and applying this criterion to public investment alternatives.

Unfortunately, the author does not mention the potential refinements in conventional water resource project analyses which are possible through the technique of linear programming and the use of electronic computers. These recent technological developments in research methods can yield information on many small incremental increases in project scale. Rather, he summarily dismisses such analyses as being too costly and believes that analyses of two or three scales of each project would be sufficient. Granted that this would be an improvement over customary procedures, it is the belief of this reviewer that the additional cost of analyzing many incremental increases in project scale would be more than compensated by the increased information gained for allocating funds to projects in accordance with their true marginal productivities. The author's reasons

for dismissing analyses of small incremental increases in scale of project hardly seem convincing in light of recent developments in research methods.

Author McKean and the RAND Corporation are to be congratulated on allocating their time and resources to preparing and making available this useful volume dealing with one of the more important and certainly not one of the least difficult problems of our times.

JOHN F. TIMMONS

Iowa State College

Information, Decision and Action, F. E. Emery and O. A. Oeser. New York: Cambridge University Press, 1958. Pp. xiii, 132. $3.75.

Information, Decision and Action, by F. E. Emery and O. A. Oeser, is a major contribution to social science. The authors depict, in full, the development, course and conclusions of a research designed to explain differential adoption of recommended agricultural practices among Australian farmers. The book's fundamental conclusion, as one may or may not expect, is that a phenomenon as complex as differential adoption can, in fact, be explained. This in itself is a highly significant finding, especially in light of the difficulties, confusion and ambiguities inherent in current American adoption research. More specifically, the authors conclude that adoption operates, primarily, as a function of exposure to sources of information relative to the recommended practices. While this finding is certainly not unknown in contemporary adoption literature, the manner in which it was revealed and the implications for related action thus developed in the present study represent unique contributions to behavioral science.

Thus, one of the main values of the present research, at least as seen by this reviewer, is the method through which "exposure" was approached and the manner in which this method lends itself to the application of findings. Through a very careful and interdisciplinary approach to the theory of social change and communications, the authors studied differential exposure through novel and imaginative indices of size of farming operation, urban influence, cognitive and intellectual skill, situational support, exposure to mass media, and "social" channels of influence. These factors, developed as trait indices, are seen to control exposure, which, in turn, controls adoption.

The key advantage of these particular explanatory variables lies in the fact that they are inherently "manipulatable." That is, they are amendable by action-oriented agencies interested in increasing exposure to information and, of course, in increasing adoption of recommended practices. This is especially evident in the case of "urban influence," and certainly apparent among the other factors noted above.

It is thus readily discernible to the reader of *Information, Decision and Action* that it is, in every meaningful way, a *complete* research. The authors have offered a great deal to the theory of social change and communications. This is especially true in the sense of codifying the most productive aspects of this theory, by developing appropriately sound hypotheses and indices and, finally, by producing explanation with respect to meaningful objectives.

Information, Decision and Action is a work of major importance to all persons in the behavioral sciences. It will certainly attract the immediate interest of rural sociologists, agricultural economists, and agricultural administrators. It must be noted, however, that the implications of this research carry far beyond the rural setting. It is, primarily, an excellent illustration of the explanatory power of science, developed through effort and imagination.

ROBERT H. FOSEN

Research Division
California Department of Corrections
Sacramento 14, California

Introduction to Agricultural Economic Analysis, C. E. Bishop and W. D. Toussaint, New York: John Wiley and Sons, Inc., 1958. Pp. xiv, 258. $5.25.

This book is a straightforward, well-organized, and clearly written analysis of major areas of economics pertaining to agriculture. It will be useful in elementary courses where students are to be given a brief view of the role of agriculture in the national economy and where the economic theory of the firm is emphasized. The analysis is presented in four parts.

Part I is a brief introduction to the functions of price, the role of agriculture, and the function of the firm as a decision-making unit.

Part II on production and supply covers 13 of the 23 chapters in the book and is the most detailed section of the analysis. It provides a thorough account of the theory of the firm under perfect competition with illustrations drawn from agricultural economics bulletins and other agricultural studies. This section is largely devoted to microeconomics. The discussion leads up to linear programming through discussion of input-output analysis, cost functions, production possibilities, and price combinations. Time and uncertainty, tenure arrangements, individual firm supply functions, and aggregate supply are included.

The balance of the book, Part III on consumption and demand, and Part IV on economic progress, is less detailed. Part III covers such subjects as consumer demand, effect of demand changes on farmers' incomes, international trade and the effect of trade on price and income, price movements, production cycles, and factors affecting prices such as credit,

location, and services. This is followed by a brief comment on parity prices.

Part IV contains three chapters on the effect of technological improvements on output, population growth and prospects, and the effect of economic progress on the level and distribution of income.

The chief merit of this book is its logical and thorough presentation of the theory of the firm with major applications of this theory drawn from situations in agriculture. The theory of competitive price is adapted to easily understood situations and the presentation should be comprehensible at the sophomore and junior level.

Judgments concerning the usefulness of the book for class presentation will depend (1) on the curriculum of the particular college and (2) on the preference of individual instructors for an introductory text. Where the curriculum calls for a careful treatment of elementary theory of the producing firm, the book should be useful. This part of the book would have somewhat wider appeal, however, if more illustrations had been drawn from studies of marketing and processing firms. Matters pertaining to agricultural policy and other macroeconomic aspects of agricultural economics are treated very briefly and without many illustrations, although what is said is illuminating and forms a useful background for other studies.

In the preface the authors claim that this book provides an elementary statement of some of the analytical tools used in agricultural economics with the object of providing a theoretical foundation for analysis of relevant problems. Tested in the light of this criterion, the book has a few shortcomings which should be noted. The authors do not discuss the statistical production function. Their notion of efficiency (page 26) at the end of Part I, as a ratio of valuable output to valuable input, seems to be a clumsy and narrowly conceived criterion for evaluating choices faced by the firm. They present this notion as the "measuring stick" for evaluating choice but do not refer to it subsequently. In some cases, such as in the discussion of tenure problems and uncertainty, the discussion could be made more meaningful by reference to institutional situations or by citing problem examples. The economic consequences of insurance and of various types of production and purchase contracts are largely ignored.

In Chapter 6 on "some applications of input-output analysis" the examples include (a) fertilizer on corn, sudan grass and fescue seed, (b) feeding of dairy cattle, laying hens, hogs and broilers. Although these are good examples, the authors fail to point out that the principles illustrated have generality in respect to all inputs. In Chapter 11 on "choice of products affects net revenue" the authors fail to indicate the highly special characters of the optima, which are maximizations of net revenue above only the costs of inputs common to the alternative products or to

such other inputs as are valued at zero opportunity cost.

Chapter 12 provides an interesting format for "enterprise budgets," evidently drawn from the format of simplex tableau in linear programming. In using this format the authors ignore the complementary and supplementary enterprise relations discussed in the preceding chapter. In Chapter 13 the authors develop the phenomena of uncertainty, but then in discussing the differences between landlords and tenants, they do not adequately develop the problems of uncertainty as faced by the landlord and tenant.

In spite of such criticism, this book will fill an important role in many agricultural curricula. Students who master the subject matter presented will have an excellent grounding in microeconomic theory and will have an accurate, although very general, picture of other important aspects of the agricultural economy. This book could be used to advantage with others which cover elementary areas of marketing and policy or with other studies in the area of macroeconomics to provide a student with a well-rounded picture of the entire agricultural economy.

Bishop and Toussaint should be congratulated on the clarity of their presentation and on the logical consistency of their outline. In reading this book one can sense why Toussaint was named Outstanding Instructor in the College of Agriculture at North Carolina State College for 1957-58.

HAROLD G. HALCROW

University of Illinois

Linear Programming Methods, Earl O. Heady and Wilfred Candler. Ames, Iowa: Iowa State College Press, 1958. Pp. vii, 597. $5.95.

The past five years have witnessed the spread of linear programming as an analytical tool to practically every land-grant college campus in America. There is no longer any doubt that this technique has, in the words of the authors, "many important applications and offers exciting opportunities in the future . . . as an important management aid to individual farm or marketing firms. The method also promises to be useful in aggregative analyses relating to regional production patterns, interregional competition and many policy problems" (p. 1).

Many will agree that "linear programming does not provide new concepts in respect to the nature of problems to be solved or the basic economic principles which define solution of these problems" (p. 19). However, the statement that "budgeting has historically supposed linear relationships" (p. 42) will meet with less general acclaim. As a matter of fact, the major criticism of linear programming among farm management workers is that it is difficult to introduce the nonlinear relationships which for years have been employed by skillful users of budgeting methods.

The major contribution made by this text is, as the title suggests, the careful step by step description of methods of numerical analysis. The two introductory chapters of this text make difficult reading, and may not captivate the imagination of graduate students or busy research people. A simple graphic analysis of a programming problem might have assisted in stimulating interest and helped to get across at an early stage and in simple form the broad outlines of the subject. However, the book is directed toward students interested in becoming proficient in the use of an analytical tool rather than toward a wide audience of general readers.

Computation of linear programming problems on desk calculators using the simplex method is the topic of Chapter 3 and is relatively easy to follow. The prospective reader should be alerted to the discussion of the dual problem which is presented in the appendix to this chapter. In many cases the dual form of stating a linear programming problem is more efficient in terms of computing time than the usual form of analysis. A rule for choosing between the two forms is given on page 107. Discussion of the simple model is expanded in Chapter 4 to include problems in which the purchase or sale of intermediate products is introduced and feed mix problems are described. The authors point out that these two types of problems can easily be handled simultaneously if that should be desired.

Research workers will also wish to pay careful attention to the short cuts and checks which are discussed in Chapter 5. Although a rather cursory discussion of coding is given in this chapter, further elaboration is provided on pages 212 and 313. Certain decisions which must be made when setting up linear programming problems are discussed in Chapter 6.

Linear programming is unique in that it offers a feasible method by which one can evaluate in an orderly fashion a wide range of resource, price and technical coefficient combinations. The construction of resource maps is discussed in Chapter 7, price maps in Chapter 8 and input coefficient maps in Chapter 16 (the reason for the location of this latter chapter is not quite clear). A helpful discussion of problems of preparing and coding data for electronic computers is provided in Chapter 9. Readers of current articles on linear programming will recognize this as an area which has received little attention.

New developments in programming methods have made several parts of this book partially obsolete. This is true, for example, with regard to the transportation model which is useful in spatial economic analyses. Presentation of this model is a relatively weak section of the Heady-Candler manuscript, although it may supplement such definitive articles as that written by Judge and Wallace in a recent issue of this *Journal*. The coverage of computational checks and the treatment of price differ-

entials among shipping points and consuming centers is inadequate. No mention is made of the extension of price mapping to provide information on the costs of making "wrong" decisions. The rather unsettled state of programming in dealing with nonlinear relationships and handling risk problems is also reflected in Chapter 17.

The discussion of Leontief input-output models provides an introduction to this topic, as does the presentation of certain ideas concerning the theory of games. However, stiff competition in these areas is offered by R. D. G. Allen,[1] Luce and Raiffa,[2] and the Dorfman, Samuelson and Solow classic.[3]

This book by Heady and Candler is certain to be used widely by agricultural economists as a handy reference work, and may be a means for eliminating many of the foolish and time consuming errors that so often crop up when a person first attempts to apply new methodological techniques.

RICHARD A. KING

North Carolina State College

A Manual of Co-operative Law and Practice by B. J. Surridge and Margaret Digby. (Prepared under the auspices of the Horace Plunkett Foundation) Cambridge, England: W. Heffer & Sons Ltd., 1958. Pp. 236. 21s net.

This book sets forth tersely and in nontechnical language a number of basic legal and practical procedures for cooperative endeavor based upon observation of operations in a wide range of countries. Although designed primarily for local cooperative officers in British Asian and African countries, it contains many sound pronouncements of interest to all those who believe that cooperative methods can contribute to the advancement of the economic well-being of people in all nations.

The strongest impression made by this book on the reviewer, as an American reader, was the striking similarity between the problems faced by cooperative endeavors in the wide range of countries considered and those faced by many farmer cooperatives in this country. There is also an equally apparent similarity between the sage and tested solutions to many of these problems suggested by the authors and the correct solution of similar problems in this country.

The book is in two parts. The first 89 pages are devoted to a description of different forms of cooperative endeavor, with particular emphasis

[1] R. G. D. Allen, *Mathematical Economics*, Macmillan and Co., Ltd., London, 1956.

[2] R. D. Luce and Howard Raiffa, *Games and Decisions*, John Wiley & Sons, Inc., New York, 1957.

[3] Robert Dorfman, P. A. Samuelson and R. M. Solow, *Linear Programming and Economic Analysis*, McGraw-Hill Book Company, Inc., New York, 1958.

on the village type credit society, which, one gathers, is the most common variety of incipient activity in most countries to which the book is beamed. Woven into this analytical review, however, are a number of wise observations on cooperative development. For example, the authors show by illustration that building cooperatives from the top down by government is not a sound approach; that it is a mistake to have any one preconceived blueprint of cooperative organization; that member knowledge and understanding of what the organization is seeking to achieve is basic; that sound financing is indispensable to success; and that management (which includes both the governing board, or "committee," and the operating personnel) must be informed, well-trained, and competent.

The highlight of this part of the book for an American is, in the reviewer's judgment, Chapter XI on "Co-operation and Education." The authors point out that cooperative movements not only make provision for education but ". . . They may be regarded as highly educational in themselves, since they give members on the one hand a training in the management of their own business and financial affairs, and, on the other an initiation into democratic responsibilities and democratic rights. The adult member of a society probably undergoes this training without noticing it, intent only on the advantages which the cooperative brings to him and his neighbours."

Many people in this country also feel that this is one of the real plus values of the cooperative method of doing business.

The second part of the book consists of commentaries on a model cooperative societies' law and rules. This part of the book naturally has less to commend it to American readers since the model law and rules are materially dissimilar from the State statutes in the United States even though there are some points of general comparison. The authors undertake a cursory comparison between the Federal Credit Union Act and the model act, but obviously attempt no similar comparison to the many statutes on co-operative marketing, purchasing and service associations found in the United States.

Aside from admirably fulfilling its immediate purpose of assembling important precedents in convenient form for cooperative officers and officials, this book should prove stimulating to persons interested in cooperation everywhere, if for no other reason than the revealing analysis which it gives of the breadth and vitality of the cooperative endeavor in many of the newer countries of the world.

RAYMOND J. MISCHLER

Office of the General Counsel
U. S. Department of Agriculture.

The Pattern of Land Tenure Reform in East Asia After World War II, Sidney Klein. New York: Bookman Associates, Inc., 1958. Pp. 195. $10.00.

This short book is a resume and evaluation of postwar land tenure conditions and land tenure reform programs in selected areas of East Asia. Chapter I, "The Setting of the Problem," indicates the book's function ". . . to examine these reforms; particularly, to examine them in the light of the economic need for them." Concentration of land ownership and abuses associated with it constitute a focus for the study. The pressure of population on scarce land resources is the dominant theme. A chapter each is given to Japan, Taiwan, South Korea, North Korea, and Communist China. The final chapter, entitled "Conclusions," recapitulates the earlier discussion. Footnotes and statistical tables for each chapter are placed in consolidated sections along with a "Selected Bibliography" and an "Appendix."

The concentrated analysis and narrow focus precludes consideration of historical or cultural factors. There is no discussion of the development of landlord and tenant classes or of rural institutions.

The chapters on the specific areas follow an identical outline: "Economic Need for Land Reform," "Land Reform Legislation and Administration," and "Accomplishment." The corresponding discussions are also repetitive. Economic need is presented in terms of per capita holdings, size of farm, rental methods, rental payments, tenant income, etc. Land reform legislation and administration is a recital of laws, ordinances, dates of promulgation, administrative structure, administrative methods, and financing of the reform. Accomplishments are presented as a statistical commentary of effects on amounts of ownership, tenancy, size of farm, tenure relations, and income redistribution.

The author tends to identify welfare with categories susceptible of numerical expression. This also precludes much consideration of political and social objectives. Those familiar with Japanese land reform operations may feel that treatment of that topic is unduly critical. There is no reference to Japan's efforts in the prewar period to reform land tenure which provided some of the groundwork for the postwar program. The chaotic conditions in Japan and to some extent in the other areas following the "Surrender" are barely mentioned. The effect of these conditions on administration of the land reform program is not discussed. But such factors as collapse of an empire, property destruction, loss of records, impairment of communication, human displacement, cultivation of urban lands, abandonment of other lands, and demobilization were bound to alter and confuse normal census classifications concerning land use and land tenure. The author, apparently unfamiliar with these conditions, makes too much of errors in statistical reporting. This is unfortunate, since

the author uses the Japanese program as reference point in discussing other areas and thus raises doubts about the validity of his discussion of those areas.

Again, there is too much emphasis on transitory problems of the Japanese program. There is a confusion of these with more basic faults of the Japanese program which make it appear that the program was quite short of success. Yet the author guardedly concedes that the program was a success. But many reservations, implicit criticisms, and direct charges are mingled with more favorable comment. Some readers will be confused by such statements as, "The attempts—to retard—the reform—were largely, but far from entirely, unsuccessful." In another passage the author charges the program with extraordinary delay in accomplishment of land rental reform but makes no effort to determine whether a more timely performance was at all possible. Altogether, the author has reached out rather far in his adverse criticism of the Japanese land reform program.

Despite its limited scope, the study does provide a direct contrast of the democratic land reforms of Japan, Taiwan, and South Korea with the Communist reforms of North Korea and Red China. This is a worthy achievement.

The essential contrast is between a peaceful reorganization of land tenure arrangements in three areas with violent revolutionary efforts, in North Korea and Communist China, to use land redistribution as a means for transformation of rural society and the mode of production. Despite deficiencies, duly noted by the author, non-Communist reforms did improve economic conditions of most tenants, and to a considerable degree, the entire peasantry. In Communist areas the conditions of tenants were not improved. Indeed the author demonstrates rather convincingly that conditions among millions of North Korean and Chinese peasants are now worse than formerly.

In view of this impressive contrast, the author's pointed ambivalence toward the Japanese land reform seems odd.

L. I. HEWES, JR.

Denver, Colorado

The Staple Food Economies of Western Tropical Africa, Bruce F. Johnston, Stanford: Stanford University Press, 1958. Pp xi, 305. $6.00.

Students of economic development long have been concerned with the place of agriculture in the development of nonindustrial and nonurban countries. Economic development as a process has depended to an unusual degree on the contribution of the rural sector, which in most underdeveloped countries includes 75 per cent or more of the population and, of course, a major proportion of the economic activity. Economic develop-

ment via industrialization and urbanization must pace itself according to what agriculture can do to increase productivity as well as to release labor for nonagricultural employment.

Johnson has described the production of staple food crops in a huge region within this framework of economic development. Literally, he has combed hundreds of sources of data in order to summarize information on the relative importance of various crops, their areas of production and their characteristics. The data presented are primarily for the starchy foods such as sweet potatoes, yams, sorghums, millets, rice and maize. Comparisons as to production costs and yields in both physcial quantities and in food calories are shown. These comparisons and associated information make this volume a sort of storehouse of production data for a little known region of the world.

One of the shortcomings of the study is that the compilation of information is for such a vast region. No exact figure is presented (or at least found) on the geographic area, but reaching from Angola on the south to the French Sudan on the north as it does, the region must be almost as large as the continental United States. With the isolation and variation in cultural factors in combination with different levels of economic development, all of which are indigenous in such economies, there may be some question as to the validity of comparisons and conclusions which are drawn on so vast a scale. Obviously, the economics of food production play only a secondary role in an economy where the need, according to an appointed colonial governor, is to "continually impress on your people that the belief that the production of rice is only a woman's crop is a thing of the past and that the men, particularly younger men, must realize that the production of essential foodstuffs of this territory is important . . ." (Pp. 182-183).

In a final chapter on prospects of increasing productivity for the requirements of economic development, Johnston has concluded, more or less, that there is nothing in the food production situation that warrants a pessimistic attitude. He cites the growth in technology, that is, better plant varieties, expanded fertilizer uses, crop rotations, insect and pest control, etc., as surely resulting in means of raising agricultural output and productivity. This reviewer, while accepting the fact that present technology is quite adequate to increase and expand agricultural productivity, cannot be very optimistic on the matter. From experience in specific programs in such areas and from study and observation of other programs, it appears that institutional and cultural factors for a time may outweigh economic and technological ones in initiating or starting an upward spiral of economic development. Many technicians are twiddling their thumbs in too many areas because they know how to grow more maize, but they are not aware of how to motivate a peasant to want to

grow more maize. Lest the reader get the wrong impression, Johnston has not overlooked the cultural and institutional barriers to raising productivity. His final conclusions appear to be that these, too, shall pass away before the onslaught of technology.

This reviewer recommends the book to students of economic development and to those interested in food production and prospects on a continent growing in importance.

JOHN H. SOUTHERN

Farm Economics Research Division, ARS

The Strategy of Economic Development, Albert O. Hirschman. (Yale Studies in Economics: 10.) New Haven: Yale University Press, 1958. Pp. xiii, 217. $4.50.

This study, based upon the author's experience as a government economic advisor and later as a private consultant in Colombia, is an effort systematically to evolve some new ways of thinking about development problems. The book is controversial; in style it appears deliberately polemical, obviously with the intention of provoking discussion. In good Ricardian fashion Hirschman argues the extreme position, adding the *caveats* almost as afterthoughts; one chapter about three-quarters the way through, for example, dealing with inflation, balance of payments and population pressures, is euphemistically entitled, "The Role of Disturbances." But this is a highly readable book, well worth the careful attention of the profession.

The central thesis is simply stated: ". . . I heartily disagree," says Hirschman, "with the 'balanced growth' doctrine" (p. 50). What is needed is deliberate *unbalanced* growth, since this is the way in which pressures for development are generated. "If the economy is to be kept moving ahead, the task of development policy is to maintain tensions, disproportions, and disequilibria" (p. 66). The crucial factor is the inducement to take development decisions, particularly the inducement to invest. Public policy should thus seek to activate latent development potentialities through "pressures" and "inducement mechanisms." The binding agent is a "growth perspective," comprising the desire for growth and, equally important, the perception of the road to it. This theme of inducement mechanisms is carried right through the book, illustrated and embellished in many ways. There is little discussion of the usual "obstacles" to development, for these are regarded as a result of, or at the most secondary to, the problem of overcoming the inability and/or unwillingness to take development decisions.

A short review cannot possibly do justice to the wealth of ideas that crop up in this book. Some of them are almost incidental asides. There are many keen insights, for example, into the sociology of development

of underdeveloped countries, for "pressures" and "inducements" are essentially social-psychological concepts. But this reviewer is troubled by a very basic consideration—in fact the point of departure for the study: Hirschman's characterization of the doctrine of balanced growth. One gets the feeling that the author has set up a straw man which he then proceeds to knock over rather easily. He asserts, for example, that balance is essentially a static concept. This is almost certainly not so. The difficulty is that one cannot find a more or less complete exposition of the balanced growth thesis. Hirschman makes some point of arguing the case for "efficient sequences" over time. But surely none of the authors he cites as favoring balanced growth would deny this. They are as much concerned with priorities and timing in development planning as with balance. Hirschman's critique should be a challenge to produce a systematic exposition of balanced growth theory.

There is a second fairly important point. Right at the end of the book Hirschman expresses his uneasiness at "the importance and creative virtue" he has bestowed on inducement mechanisms. In particular, he raises the question of whether the responses may be *destructive* rather than constructive in character. This is a rather damaging admission, one a reader is likely to take as an invitation to re-examine the entire thesis!

A few minor criticisms may be noted. There are many categorical statements neither theoretically defended nor empirically illustrated. There is not a single reference to Colombia until halfway through the book, a result, perhaps, of the desire to present a general theory, but nonetheless disconcerting in view of the author's experience there. The title may be somewhat misleading in that a reader may regard the study as a handbook for development planners; except for a few isolated statements (e.g., p. 152) this is not so, for the book is mainly a set of hypotheses about the development process.

BERNARD GOODMAN

Wayne State University

Microeconomic Theory: A Mathematical Approach, James M. Henderson and Richard E. Quandt. New York: McGraw-Hill Book Co., Inc., 1958. Pp. xii, 291. $7.50.

Mathematical economics has not yet found a secure niche in the curriculum of agricultural economics, particularly the undergraduate curriculum. Of all the recent volumes on the subject to appear, Henderson and Quandt's will, I predict, best satisfy the growing needs of Departments of Economics and Argicultural Economics for undergraduate training in mathematical economics.

By restricting attention to microeconomic theory, Henderson and Quandt leave out such interesting topics as models of economic growth

and development, business cycle models and the like. But this is not necessarily an evil, for limits must be set somewhere and microeconomics is not only a valuable subject in itself but a necessary prolegomenon to the study of macroeconomics.

The first two chapters of *Microeconomics* are devoted to the pure theories of producer and consumer behavior under conditions of perfect competition as expounded by Allen, Hicks and Samuelson in the 'thirties and 'forties. Ordinal utility, indifference curves and surfaces, income and substitution effects, the theory of revealed preference, and the possibility of utility measurement under conditions of uncertainty are clearly discussed with the aid of numerical examples and diagrams. The notion of a production function is introduced and cost minimization and profit maximization are treated as a mathematical problem in finding the extreme points of a function of several variables subject to a single constraint. One of the most useful aspects of these chapters is the explicit derivation of demand and cost functions from the first-order conditions for maximum utility and minimum cost, respectively. Euler's theorem is treated a bit superficially and the authors seem unaware that production functions homogeneous of degree other than one have been widely used in empirical work. The chapter on the theory of the firm closes with a brief section on linear programming showing its relationship to the more general topics of production functions and profit maximization.

The succeeding two chapters deal with the equilibrium of an isolated market and a system of multiple, interconnected markets. After deriving aggregate demand and supply functions and discussing external economies and diseconomies, the authors treat static equilibrium, qualitative criteria for stability, and criteria based on explicit dynamic models of adjustment over time, such as the price adjustment model and the cobweb model. The theory of static equilibrium in a single market is applied to the problem of spatially separated firms (an old one in the economic analysis of the production of dairy products) and to the question of the effects of different types of taxation. The discussion of multimarket stability in the chapter on the theory of general equilibrium of a system of markets is the best elementary treatment I have seen. This chapter closes with a short discussion of input-output analysis which the authors rightly treat as a specialization and simplification of general equilibrium theory.

In the derivation of the aggregate demand function for a single commodity, Henderson and Quandt hold money income (not real income) constant. Their flat statement (pages 88 and 95) that the resulting demand function is monotonically decreasing is false as a general statement. They have in effect neglected their earlier discussion of the income and sub-

stitution effects of a price change.[1] We also find in the chapter on general equilibrium the misleading notion that the second-order conditions for maximum utility must be satisfied in order to derive the excess demand functions from the first-order conditions (pages 130 and 136). This is in no sense true; what the second-order conditions do in fact is to tell us something about the properties of the solution once we have it, not permit us to get it in the first place.

Less an error than a poor choice is Henderson and Quandt's treatment of external economies and diseconomies by introducing the quantities produced by other firms in an industry into the cost function of a single, representative, firm. This approach obscures the fact that the economies or diseconomies occur because the supply functions for factors are not perfectly elastic to the industry—though they may be to the individual firm. A more unified and transparent approach can be obtained by treating the industry supply function as a partially reduced form. This approach has the advantage of yielding empirically testable theorems which Henderson and Quandt's does not.[2]

In many ways the economic theory of monopolistic competition is less amenable to mathematical treatment than the theory of perfect competition. Nonetheless, the authors' heroic attempt (Chapter 6) to place the theory in a mathematical framework, though somewhat unsatisfying, makes interesting reading and clarifies a number of important points. Especially useful is their discussion of duopoly and oligopoly models in which they place the theory of games in proper perspective, i.e., as one of several possible and meaningful theories.

The chapter on modern welfare economics (Chapter 7) is especially notable for its clear presentation and proof that, in the absence of external economies or diseconomies, perfect competition leads to a welfare optimum in a Pareto sense.

In the final chapter, multi-period consumption and production are treated in a purely formal manner by the simple expedient of the addition of a time dimension. Though this approach permits the discussion of such topics as time preference and interest rate determination and is formally correct, it is not especially enlightening. The essence of dynamic eco-

---

[1] This neglect is reflected in Henderson and Quandt's use of the term "gross substitute" page (127) without adequate definition. If x is a gross substitute for y, the cross-elasticities of the excess demand functions are positive; whereas, in order that x be a mere substitute for y, we need only require that the substitution effects (real income held constant) be positive.

[2] In order to judge for himself, the reader may wish to compare Henderson and Quandt's discussion of external economies and diseconomies with my own in *The Dynamics of Supply* (Baltimore: The Johns Hopkins Press, 1958), pp. 35-44.

nomics, even on the micro level, lies not in reducing its problems to the static case through the addition of temporal subscripts, but in examining the "structure" of optimal solutions.[3]

As a reasonably elementary exposition of economic principles in mathematical form, *Microeconomics* has no equal. Not only does it cover the ground well but it puts such esoteric topics as linear programming, input-output analysis, and the theory of games in their proper places. A brief but excellent review of the relevant mathematics is contained in an appendix which, as the authors point out, is not adequate for the reader who has never been exposed to calculus but is designed primarily as an aid to memory. Such honesty is as valuable as it is refreshing.

Perhaps the major short-coming of *Microeconomics* is the fact that the highly important and useful notion of comparative statics is not once explicitly mentioned. As Samuelson pointed out over a decade ago, comparative statics is the essence of most economic theory and the most fruitful applications of mathematics in economics have been to problems in comparative statics.[4] Emphasis on what comparative statics is and how it leads to many of the empirically meaningful propositions of economic theory would have enhanced the usefulness of this already valuable book.

For undergraduates who have had courses in elementary and intermediate calculus, *Microeconomics* will be a good text for a one-semester course in economic theory. For students, however, who have had substantial training in economic theory but little or no training in mathematics, this book must be supplemented. Since mathematics, as taught in mathematics departments with emphasis on physical applications is likely to be somewhat forbidding to the economics or agricultural economics major, the last mentioned group may well be large. With such a group one might plan a two-semester course using a standard calculus text to accompany Henderson and Quandt. The dearth of exercises in *Microeconomics* detracts to some extent from its utility in this respect, but its broad coverage and clarity of exposition more than compensate.

MARC NERLOVE

University of Minnesota

[3] The best statement of this position I know of may be found in Richard Bellman, *Dynamic Programming* (Princeton: Princeton University Press, 1957), especially pp. vii-xi. Bellman's book is a comprehensive application of the principle of the unimportance of mere dimension to the problems of decision making over time.

[4] Paul A. Samuelson, *Foundations of Economic Analysis* (Cambridge: Harvard University Press, 1947).

NEWS NOTES

KAEISTER ADAM, former University of Maryland graduate assistant, is now with the Dairy Division, AMS.

RICHARD A. ANDREWS completed his Ph.D. work at the University of Minnesota and has joined the staff at the University of New Hampshire.

RICHARD D. APLIN was appointed Assistant Professor at Cornell University on February 1.

RALPH L. BAKER, after spending six months with AMS studying egg production and marketing programs, has returned to his position as Professor at Pennsylvania State University.

CALVIN L. BEALE, Head, Farm Population Section, AMS, received a special award March 2 for special contributions in research on demographic fields related to agriculture. Others receiving awards at the same time: GLADYS K. BOWLES, Farm Population Section, AMS, for skill in studies of movement of people to and from farms and of potential labor supply of the farm population; HAROLD BREIMYER, Head, Livestock, Fats and Oils Section, AMS, jointly with section associates, for contribution to accuracy of economic outlook activities; MARGARET F. CANNON, AMS, for skill developing and interpreting estimates of farm marketing receipts; ROBERT E. POST, Head, Food and Feed Grains Section, AMS, for contribution to public understanding of economic forces which generate wheat and rice surpluses.

RICHARD E. BELL, former University of Maryland graduate student, has joined the Foreign Agricultural Service in Washington.

LLOYD D. ENDER completed his Ph.D. at the University of Missouri and has joined the staff at the University of Arkansas.

JOHN BLACKMORE has been made Chief of the Land Use and Farm Management Branch of the FAO in Rome.

HERMAN BLUESTONE has transferred to the Agricultural Economics Division, AMS, and will research milk, manufactured dairy products, poultry, and eggs.

CHARLES R. BRADER has joined the Fruit and Vegetable Division, AMS, in the Washington office.

JOHN R. BRAKE, presently completing his Ph.D. at North Carolina State College, will join the agricultural economics staff at Michigan State University as Assistant Professor, July 1.

EMERSON M. BROOKS, Chief, Special Statistics Branch, AMS, was made a member of Phi Alpha Theta, national honorary society in history, at a ceremony at American University.

CHRISTY G. BROST has transferred to the Department of the Interior from the Lincoln, Nebraska, office of the Farm Economics Research Division, ARS.

DALE E. BUTZ has resigned from Michigan State University to become Director of Marketing Research at Illinois Farm Supply Company. He has been Visiting Professor at Harvard University on leave from Michigan State.

W. F. CALLANDER, retired director of Agricultural Estimates Division, AMS, received the honorary degree, Doctor of Science, from University of Florida for his achievements in the field of statistical data.

KEITH CAMPBELL, on sabbatical leave from the University of Sidney, Australia, is advising FAO on dairy marketing problems. He will visit several U.S. universities during 1959.

VIRGIL C. CHILDS, who retired as Statistician in Charge of the Austin, Texas AMS office, spent four months in Seoul, Korea, working with the International Cooperation Administration on means of improving Korea's agricultural statistics.

W. A. COVINGTON, AMS, has transferred to the Columbus, Ohio office.

REX F. DALY, AMS, has transferred to International Cooperation Administration and will be gone two and one-half years working with the government of Pakistan.

CARLETON C. DENNIS will begin as Assistant Professor at Michigan State University June 15.

MARSHALL DICKERSON, Dairy Division, AMS, transferred to Federal Milk Market Office in Boston in September, 1958.

BENNETT A. DOMINICK, JR., agricultural economist, AMS, is on sabbatical leave from Cornell University in order to appraise research of the Merchandising Methods Section, AMS.

LOUIS J. DUCOFF, Assistant Chief, Farm Population and Rural Life Branch, AMS, has returned to this post after a 13-month absence to work on a U.N. assignment in Central America and Mexico studying demography in relation to economic development programs.

PHILIP B. DWOSKIN AND MILTON JACOBS have received an award from the Washington chapter of the American Marketing Association for their publication, "Potato Flakes—A New Form of Dehydrated Mashed Potatoes: Market Position and Consumer Acceptance in Binghamton, Endicott, and Johnson City, New York."

WALTER H. EBLING, Statistician in Charge of the AMS Madison, Wisconsin, office, was recognized with five others by the Wisconsin Council of Agricultural Cooperatives for continuing contribution to the state's agriculture.

CLARK EDWARDS is an Assistant Professor at Oklahoma State University after completing his Ph.D. at Michigan State University.

JOHN EDWARDS, University of Chicago graduate student, has accepted a position as Assistant Agricultural Economist and Assistant Professor at the University of Idaho.

WILLIAM EICHBERGER, Farm Economics Research Division, ARS, has transferred from Little Rock, Arkansas, to Washington, D.C.

JAMES ESMAY, Farm Economics Research Division, ARS, has transferred from Montana to Moscow, Idaho.

MORDECAI EZEKIEL is now serving as Acting Director of FAO's Department of Economics and as Economic Advisor to the Director-General.

ERNEST FEDER has rejoined the University of Nebraska staff after a year lecturing at the Universities of Chile, Lima, Cuzco, LaPaz and Buenos Aires under a Fulbright grant.

BENJAMIN FRENCH resigned from Michigan State University in December, 1958, to take a position at the University of California.

CAMERON G. GARMAN, independent fruit grower, served as Acting Professor at Cornell University during the winter months to supervise work on farm and home management records.

KARL GERTEL, Farm Economics Research Division, ARS, has transferred to the Washington office from University Park, Pennsylvania.

CHARLES GIBBONS, Chief of Trade Statistics Section, FAO, will be in the U.S. this summer on leave.

Earl R. Glover, presently on assignment in Latin America, has been named Assistant to the Deputy Administrator for Marketing Research and Statistics, AMS.

Loyd Glover has succeeded L. T. Smythe as Head of the economics department, South Dakota State College.

Philip Goorian, with the Farm Economics Research Division, ARS, since September, 1958, transferred in January to the Department of the Interior, Sacramento, California.

Charles P. Gratto has accepted an appointment as Research Assistant at Pennsylvania State University.

T. M. Hadfield, Dairy Division, AMS, has transferred from the Cleveland, Ohio, Office to San Francisco Market News Office as Officer in Charge.

Arthur B. Hamilton, Professor at the University of Maryland, has been elected National President of Alpha Gamma Rho Fraternity.

Arthur F. Hanau, University of Gottingen, West Germany, is Visiting Professor at the University of Minnesota during the spring quarter.

Charles M. Hardin, University of Chicago, instructed a graduate seminar on "Agriculture and Agricultural Policy in American Politics" at Pennsylvania State University the week of March 16. Other recent seminars on this campus include: "Decision Making by Agricultural Firms," conducted by Glenn L. Johnson of Michigan State University; "Problem of Economic Development in Backward Areas," conducted by James G. Maddox, North Carolina State College; "Population-Resource Interrelationships, Adjustments and Institutions," conducted by John F. Timmons, Iowa State College.

Roland G. Harris, formerly with AMS, is now with the Pennsylvania Department of Agriculture.

Robert Harrison is now with the Washington staff of the Farm Economics Research Division, ARS.

George R. Harvey, Office of the Agricultural Statistician, Sacramento, California, AMS, retired December 31, 1958, after 28 years and five months of government service.

D. G. Harwood, formerly Extension Farm Management Specialist at North Carolina State College has been appointed Rural Development Specialist.

Arnold F. Haseley, formerly extension marketing agent in Retail Marketing program, Albany, New York, joined the Extension staff at Purdue University as specialist in retail marketing, January 1.

Carroll V. Hess, formerly with ARS at Cornell University, has joined the staff of the University of Minnesota as Associate Professor.

Max K. Hinds, economist in dairy marketing with the Federal Extension Service since 1950, has transferred to ARS.

Shelby Holder, who received his M.S. degree at the University of Arkansas, has joined the staff of the Market Organization and Costs, AMS.

Mary A. Holman has been appointed to the Income and Demand Section, AMS, as an economist.

Herman W. Isenstein has been appointed to the Income and Demand Section, AMS.

J. Dean Jansma joined the Washington staff on the Farm Economics Research Division, ARS, in November.

Aaron C. Johnson, Jr. has resigned as Assistant Agricultural Economist at the Main Agricultural Experiment Station and taken a position with John Baxter Brothers, Hartland, Maine.

ELDON L. JOHNSON, formerly with the State Statistician's Office at Little Rock, Arkansas, has transferred to the Columbus, Ohio, office.

ROBERT L. JOHNSTONE joined the North Carolina State College staff, February 15, as Extension Farm Management Specialist.

HAROLD K. JOLLEY has joined the staff of the Fruit and Vegetable Division, AMS.

HUMBERT S. KAHLE has transferred from the Market Organization and Costs Branch, AMS, to the Commodity Stabilization Service.

WILLIS KEARL has joined the staff of the Farm Economics Research Division, ARS, in California.

MIRIAM KELLEY has been appointed Assistant Director of the Agricultural Extension Service at Michigan State University, in charge of Home Economics.

MYRON P. KELSEY began his duties at Michigan State University as a member of the Extension staff on February 1, transferring from Purdue University.

JAMES R. KENDALL, Office of the Crop Board Secretary, AMS, transferred to the Feed Grain and Hay Crops Section.

ORVAL KERCHNER joined the Washington staff of the Market Organization and Costs Branch, AMS, in October after receiving the M.S. degree at the University of Illinois.

ROBERT KOCH has joined the staff of Rutgers University after completing his Ph.D. at Purdue University.

MELVIN L. KOEHN has transferred from Sioux Falls, South Dakota Agricultural Statistician's Office, AMS, to the Office of the Crop Board Secretary.

NATHAN KOENIG, Administrator's staff member, AMS, went to Brazil during September and October 1958, at the invitation of the Food Supply Coordinating Council of Brazil, to make a general study and appraisal of its agricultural industry.

HARVEY KORSLUND, JR., transferred from Dairy Division, AMS, to the Fayetteville, Arkansas, field office.

WILLIAM G. LANGSTON has joined the University of Maryland staff as Extension Marketing Specialist. He is also serving as Chairman of the Egg Production Committee for the state of Maryland.

KARL LINDEBORG, who completed work for Ph.D. at Oregon State College, has accepted a position as Assistant Agricultural Economist at the University of Idaho.

CLEM C. LINNENBERG, JR., formerly in charge of Transportation Economics Research, AMS, transferred to the Department of Health, Education, and Welfare as Chief of the Division of Statistics and Studies.

FRED MANGUM has joined the North Carolina State College as Farm Management Specialist.

WILLIAM MANNLEIN, Farm Economics Research Division, ARS, has transferred from the Paris, Arkansas, office to Des Moines, Iowa.

GERALD MAROUSEK has returned to the staff of South Dakota State College after a leave of absence to complete his Ph.D. degree at Oklahoma State University.

W. W. MCPHERSON has resigned as Professor at North Carolina State, effective July 1, to accept a position as Head of Economics Research with United Fruit Company.

EDWARD S. MICKA, Farm Economics Research Division, ARS, has moved his headquarters from Durham, New Hampshire, to Storrs, Connecticut.

Ronald L. Michell, Farm Economics Research Division, ARS, has been named leader of a pioneering research group which will study interfirm integration in farming.

C. Clyde Mitchell has been appointed chief of the FAO Mission in Colombia, South America. He has been adviser to the Pakistan government since 1957, working with the Harvard Advisory Project to the National Planning Commission.

Herman L. Myers has been appointed Program Officer and Economist of the International Cooperation Administration Mission in Mexico City.

Marc Nerlove is now Associate Professor at the University of Minnesota having completed his service in the U.S. Army.

W. Glenn O'Neal, former University of Georgia graduate student, has accepted a position as Agricultural Economist with the Tennessee Valley Authority.

Donald Osbun, will serve as USDA collaborator with the Farm Economics Research Division, ARS, at Iowa State College.

O. T. Osgood, FAO farm management expert in Iran, is presently in the U.S. on home leave.

Jerome Pasto is returning to Pennsylvania State University after a two-year assignment with FAO.

Harold C. Phillips, transferred from the Field Crops Statistics Branch, AMS, to become Head, Farm Employment Section, AMS.

Paul S. Rabin has accepted an appointment to take the training program in Market News, Dairy Division, AMS, at Atlanta, Georgia.

John R. Raeburn of the London School of Economics has been appointed Professor and department head at the University of Aberdeen.

Marius P. Rasmussen, Professor at Cornell University, retired February 1 after 38 years of service. His plans include writing on marketing and early Danish history.

Oakley M. Ray, formerly with the American Meat Institute, has joined the staff of the American Feed Manufacturers Association as Director of Market Research.

Fred R. Robertson has been named Assistant to the Director of Agricultural and Home Economics Extension at Pennsylvania State University.

Frank H. Robinson has joined the Washington staff of the Farm Economics Research Division, ARS.

Paul E. Rosenberry has taken a position with the Livestock Division, AMS, in the Washington office after completing his M.S. degree at the University of Nebraska.

Glenn Samson has joined the Washington staff of the Market Organization and Costs Branch, AMS, after completing his M.S. degree at the University of Nebraska.

Rainer Schickele has been named Director of the Division of Land and Water Development, FAO.

Robert B. Schwart has joined the University of Illinois staff as an extension specialist in farm management.

Richard L. Simmons has joined the staff at North Carolina State College.

J. Marvin Skadberg has joined the Iowa State College staff after receiving his M.S. degree at North Dakota Agricultural College.

Harold D. Smith has returned to the University of Maryland after doing postdoctorate work at the University of Chicago.

HERMAN M. SOUTHWORTH, Department of Agricultural Economics, Pennsylvania State University, will assume the duties of Editor of the *Journal of Farm Economics* beginning with the November issue. All new manuscripts submitted for publication should be sent directly to him.

ROBERT D. STEVENS has been appointed Acting Assistant Professor at Cornell University. He will replace JOHN W. MELLOR who has gone to India on a fellowship granted by the Council on Economic and Cultural Affairs.

CHRISTIAN A. STOKSTAD has transferred from the State Statistician's office at Seattle, Washington, to the Washington, D.C., office of Agricultural Estimates Division, AMS.

HARRY A. SULLIVAN has joined the Fruit and Vegetable Division, AMS, in the Washington office.

WESLEY B. SUNDQUIST, Farm Economics Research Division, ARS, formerly stationed at East Lansing, Michigan, has transferred to St. Paul, Minnesota.

DANIEL A. SWOPE has been appointed Assistant Professor at the University of Maryland.

GARY TAYLOR has joined the staff of the Farm Economics Research Division, ARS.

M. E. THIGPEN has joined the staff at North Carolina State College.

SAM H. THOMPSON, Professor of Economics at Iowa State College, retired March 1. He came to Iowa in September, 1914, from USDA as the first extension economist in Iowa and has served in a variety of ways since that time in public service. He expects to devote considerable time to studying and writing on problems of world peace, which have engaged his interest for several years. He will maintain an active part in public affairs generally and serve as a consultant in livestock and cooperative marketing fields.

GERHARD TINTNER, Iowa State College, is on leave of absence to teach econometrics during the spring quarter at Technical University, Lisbon, Portugal, at the request of the U.S. State Department.

ROBERT L. TONTZ has been appointed Chief of the Trade Statistics Branch of the Foreign Agricultural Service, USDA.

AKIRA UCHIDA has completed work for his Ph.D. at Purdue University and accepted the appointment of Research Associate at Pennsylvania University.

R. J. VAN HOUTEN, Dairy Division, AMS, has transferred from the New York Market News office to the Philadelphia office as Officer in Charge.

RAY F. VOEKEL has joined the staff of the Fruit and Vegetable Division, AMS.

S. T. WARRINGTON has transferred to the staff of the Deputy Administrator for Marketing Services as Assistant to the Deputy. He has served in many other government and private industry positions through the years.

RICHARD N. WEIGLE has returned to the Purdue University staff after spending 10 years in professional management work.

HYMEN WEINGARTEN, Price and Trade Research Section, AMS, has received an award for outstanding accomplishment in work with electrical computers for measurement of economic relations.

DALTON L. WILSON has transferred from the Market Organization and Costs Branch, AMS, to the Livestock and Meat Products Division of the Foreign Agricultural Service.

SYMPOSIUM ON THE ECONOMICS OF WATERSHED PLANNING

The symposium on the economics of watershed planning will take place in Knoxville, Tennessee, at the Hotel Farragut, June 10-12, 1959.

The aims are to provide participants with a knowledge of what is involved in watershed planning, to provide them with the opportunity to think through watershed problems in which they are interested, and to make a research contribution to watershed planning.

Participation by personnel from the Southeast is emphasized, but persons from other regions are also invited.

The symposium is sponsored by the Southeast Land Tenure Research Committee, the Tennessee Valley Authority and the Farm Foundation. The program has been planned by the Subcommittee on Water Resources of the Southeast Land Tenure Research Committee.

For information, write Prof. G. S. Tolley, Dept. of Agricultural Economics, North Carolina State College, Raleigh, N.C.

WORLD AGRICULTURAL ECONOMIC ABSTRACTS

Arrangements to include abstracts of United States publications of agricultural economics research in a world journal are being developed by the U. S. Council of the International Conference of Agricultural Economists. Dr. Sigmund von Frauendorfer of Vienna, Austria, will edit the quarterly publication of *World Agricultural Economic Abstracts*. The first issue is now in press. Subscriptions for the abstracting service should be sent to the North Holland Publishing Company, Post Office Box 103, Amsterdam, Holland. The annual subscription will be $12.00.

Harry C. Trelogan has been asked by the Council to serve as chairman of the group of specialists who have agreed to accept primary responsibilities for preparing abstracts in their respective subject matter areas. Charles E. Rogers of the Agricultural Marketing Service will serve as U. S. secretary. In this capacity he will assemble the abstracts from the group of abstractors each quarter and forward them to the editor.

U. S. members of the American Farm Economic Association are invited to send for abstracting, copies of their bulletins and major articles in the several subject matter areas to the specialists noted below. Because of the wide range of published research to be covered and the limitations of funds, choices must be made among publications to be abstracted. Dr. von Frauendorfer as editor has the final responsibility for such choices. Published materials for abstracting may be addressed to those listed, all of whom are located in the U. S. Department of Agriculture, Washington 25, D. C.

Name	*Subject Matter*	*Division*	*Service*
Dr. Margaret Hagood	Rural Sociology	Agricultural Economics	Agricultural Marketing
Dr. James P. Cavin	Agricultural Economics	Agricultural Economics	Agricultural Marketing
Dr. Winn F. Finner	Marketing	Marketing Research	Agricultural Marketing
Mr. Mark M. Regan	Land Economics	Farm Economics Research	Agricultural Research
Mr. Warren R. Bailey	Farm Management	Farm Economics Research	Agricultural Research
Dr. John M. Brewster	Farm Management	Farm Economics Research	Agricultural Research
Mr. J. Kenneth Samuels	Cooperation	Marketing Research	Farmer Cooperative
Dr. Fred L. Garlock	Agricultural Credit	Farm Economics Research	Agricultural Research
Mr. Walter A. Hendricks	Agricultural Statistics	Agricultural Estimates	Agricultural Marketing
Dr. Marguerite C. Burk	Consumption Economics	Agricultural Economics	Agricultural Marketing
Mr. Karl G. Shoemaker	Extension	Agricultural Economics	Federal Extension
Dr. Wayne D. Rasmussen	History	Agricultural Economics	Agricultural Marketing
Mr. Anthony S. Rojko	Econometrics	Agricultural Economics	Agricultural Marketing
Dr. Charles E. Rogers	U. S. Secretary	Marketing Information	Agricultural Marketing

PH.D. DEGREES CONFERRED IN AGRICULTURAL ECONOMICS

Babu Lal Agrawal, B.S. Agra University, India, 1947; M.S. Agra University, India, 1949; Ph.D. Cornell University 1958, A Study of Agricultural Cooperatives in Western Uttar Pradesh (India) with Special Reference to Agricultural Credit.

Carl J. Arnold, B.A. Virginia Polytechnic Institute 1951; M.S. Virginia Polytechnic Institute 1952; Ph.D. Michigan State University 1958, An Analysis of the Base-Surplus Plan Used in Selected Virginia Milk Markets.

Henrik J. Aune, B.S. University of Minnesota 1947; M.S. University of Minnesota 1953; Ph.D. University of Minnesota 1958, An Economic Analysis of Labor Inputs in Dairying as Affected by Size of Herd and Types of Equipment.

Marto A. Ballesteros, M.A. University of Madrid, Spain, 1950; A.M. University of Chicago 1954; Ph.D. University of Chicago 1958, Argentine Agriculture, 1908-1954: A Study in Growth and Decline.

John Toscan Bennett, A.B. Harvard University 1950; M.S. University of California 1952; Ph.D. University of California 1958, An Economic Analysis of Market-Control Programs for California Clingstone Peaches.

Richard L. Bere, B.S. Ohio State University 1952; M.S. Ohio State University 1953; Ph.D. Ohio State University 1958, An Economic Analysis of the Grading, Packaging, and Marketing of Apples, With Special Reference to Pre-packaged Apples.

Calvin Randal Berry, B.S.A. University of Arkansas 1952; M.S. University of Arkansas 1953; Ph.D. Purdue University 1958, An Economic Analysis of Fertilizer Marketing and Pricing with Particular Reference to Indiana.

Charles F. Bortfeld, B.S. University of Nebraska 1937; M.A. University of Nebraska 1939; Ph.D. University of Minnesota 1958, Production Alternatives in Response to Price Changes for a 320-Acre Wheat-Beef Farm in South Central Kansas.

Vere E. Bufton, B.S. Wisconsin State College, Platteville, 1939; M.S. University of Wisconsin 1949; Ph.D. University of Wisconsin 1958, Wisconsin Vegetables for Commercial Processing: Production, Producing Areas, and Markets.

William N. Capener, B.S. Utah State University 1952; M.S. Utah State University 1953; Ph.D. University of Illinois 1958, An Enterprise Analysis of Commercial Laying Flocks on Illinois Farms.

Harold Ola Carter, B.S. Michigan State University 1954; M.S. Michigan State University 1955; Ph.D. Iowa State College 1958, Regional Input-Output Analysis of Agriculture and Industry.

T. P. Crigler, B.S. Arkansas State College 1952; M.S. Cornell University 1955; Ph.D. Oklahoma State University 1958, A Method of Economic Analysis for Decision Making by Cooperative Elevator Associations.

Charles R. Davenport, B.S. University of Maryland 1950; M.S. University of Maryland 1954; Ph.D. University of Maryland 1958, The Functional Basis for Land Utilization.

George Robert Dawson, B.S. New Mexico A & M College 1950; M.S. University of Missouri 1955; Ph.D. Cornell University 1958, Economics of Forage Production and Utilization, North Country Region, New York, 1955-56.

JOHN P. DOLL, B.S. Montana State College 1953; M.S. Montana State College 1955; Ph.D. Iowa State College 1958, Evaluation of Alternative Algebraic Forms for Production Functions.

AKHILESH DUBEY, B.S. Bihar University, India, 1952; M.S. Oklahoma A & M College 1955; Ph.D. Ohio State University 1958, The Effects of the St. Lawrence Seaway on Ohio Wheat Marketing.

DIEDRICH DYCK, B.S. University of Saskatchewan 1954; M.S. University of Nebraska 1956; Ph.D. University of Wisconsin 1958, Enterprise Selection for the Economic Development of Part-Time Farms in Wisconsin.

CLARK EDWARDS, B.A. University of Missouri 1952; M.S. Purdue University 1956; Ph.D. Michigan State University 1958, Resource Fixity, Credit Availability and Agriculture Organization.

ALVIN CHARLES EGBERT, B.S. University of Kentucky 1954; M.S. University of Kentucky 1955; Ph.D. Iowa State College 1958, Programming Regional Adjustments in Resource Use for Grain Production.

DONALD EDWARD FARRIS, B.S.A. University of Arkansas 1950; M.S. University of Arkansas 1951; Ph.D. North Carolina State College 1958, Interregional Competition in Fresh Vegetables.

KENNETH R. FARRELL, B.S.A. Ontario Agricultural College 1950; M.S. Iowa State College 1955; Ph.D. Iowa State College 1958, Economic Aspects of Grain Storage in North Central United States.

FARHAD GHAHRAMAN, B.L. University of Teheran, Iran, 1948; B.S. University of California 1953; Ph.D. University of Minnesota 1958, The Right of Use and Economics of Irrigation Water in Iran.

DANA CLEMENT GOODRICH, JR., B.S. Rutgers University 1954; M.S. Cornell University 1956; Ph.D. Cornell University 1958, Marketing Shell-less Eggs.

ROBERT LLOYD GUSTAFSON, B.S.E. (Law) University of Michigan 1940; A.M. University of Chicago 1951; Ph.D. University of Chicago 1958, Carryover Levels for Grains: A Method for Determining Amounts that are Optimal Under Specified Conditions.

NADIM GEORGE HAJJAR, A.B. American University of Beirut, India, 1945; Ph.D. University of California 1958, Intraregional Trade in the Arab Near East with Emphasis on the Products of Agriculture.

JOHN T. HARRIS, B.S. University of Georgia 1948; M.S. University of Illinois 1950; Ph.D. University of Illinois 1958, An Analysis of Capital Use on Owner-Operated Farms in the Lower Piedmont Area of Georgia.

REX DAVID HELFINSTINE, B.S. Iowa State College 1932; M.S. Iowa State College 1947; Ph.D. University of California 1958, An Economic Comparison of Dry-Land Farming and Potential Irrigation Farming in Central South Dakota.

EDWARD B. HOGAN, B.A. San Jose State College 1949; M.S. University of Wisconsin 1951; Ph.D. University of Wisconsin 1958, An Analysis of the Rate of Adoption of a Differentiated Commodity Form: A Case Study of Chicken Meat Marketing.

GANIYU A. JAWANDO, B.S. Arizona State College 1954; M.S. University of Minnesota 1955; Ph.D. University of Minnesota 1958, The Role of Agriculture in the Economic Development in Nigeria.

CLARENCE JENSEN, B.A. Montana State College 1951; M.S. Montana State College 1952; Ph.D. Michigan State University 1958, The Effects of Urbanization on Agricultural Land Use in Lower Michigan.

JACK D. JOHNSON, B.S.A. University of Georgia 1946; M.S.A. University of Georgia 1947; Ph.D. Iowa State College, 1958, Economic Factors Affecting Cattle Prices at Appalachian Auctions.

ELMER RUDOLPH KIEHL, S.B. University of Missouri 1942; A.M. University of Missouri 1950; Ph.D. Harvard University 1958, Consumer Evaluation of the Product Characteristics of Beef.

LAUREL DUANE LOFTSGARD, B.S. North Dakota State College 1954; Ph.D. Iowa State College 1958, Linear Programming of Dynamic Plans for an Actual Farm and Household.

JOHN WILLIAM MAMER, B.A. San Diego State College 1946; Ph.D. University of California 1958, The Generation and Proliferation of Agricultural Hand-Laborsaving Technology: A Case Study of Sugar Beets.

WILLIAM TANNER MANLEY, B.S. University of Kentucky 1951; M.S. University of Kentucky 1955; Ph.D. University of Florida 1958, Consumers' Use Of and Opinions About Florida Avocados.

GENE MCMURTRY, B.S. Colorado A. & M. College, 1954; M.S. Purdue University, 1956; Ph.D. Purdue University 1958, The Response of Farmers to Various Soil Bank Proposals in Selected Areas of the Corn Belt.

CHAIM MENDELSOHN, B.S. University of California 1955; Ph.D. University of California 1958, International Trade in Oranges: Competition for Export Markets.

JOHN ANTHONY MOLLETT, B.S. University of Reading, England, 1945; M.S. University of Reading, England, 1949; Ph.D. University of California 1958, Britain's Agriculture Dilemma: A Study of Farm Policies and Programs 1920-1957.

HUGH L. MOORE, B.S. Ohio State University 1951; M.S. University of Wisconsin 1955; Ph.D. University of Wisconsin 1958, Adjustments to Bulk Procurement in Federal Order Pricing in Chicago.

STANTON PARRY, B.A. Cornell University 1952; M.S. Michigan State University 1953; Ph.D. Michigan State University 1958, Some Problems in Estimating Federal Milk Order Regulations in Michigan.

GEORGE ANTHONY PAVELIS, B.S. Montana State College 1950; M.S. Montana State College 1954; Ph.D. Iowa State College 1958, Economic Planning Within Small Agricultural Watersheds.

IGNATZ JAMES PIKL, JR., B.A. University of Wyoming 1949; M.A. University of Wyoming 1950; Ph.D. Vanderbilt University 1958, Economic Problems of Pine Pulpwood Production in the South and in the Hiwasee Region.

HANS PILHOFER, S.G.L. Höhere Ackerbauschule Triesdorf, Germany, 1950; M.S. University of Minnesota 1952; Ph.D. University of Minnesota 1958, The Interrelationship of Farm Mechanization and Organization in Decision Making.

EDWARD FRANKLIN RENSHAW, B.S. Washington State College 1954; A.M. University of Chicago 1955; Ph.D. University of Chicago 1958, An Economic Appraisal of Public Investment in Irrigation.

WILLIAM T. RICHIE, B.S. Georgia State College 1941; M.S. Ohio State University 1948; Ph.D. Ohio State University 1958, History and Development of Agricultural Cooperatives in Ohio.

NORMAN KIETH ROBERTS, B.S. Iowa State College 1948; M.S. Iowa State College 1949; Ph.D. University of Kentucky 1958, The Economics of Dairy Pasture Production.

LOY LUTHER SAMMET, B.S. Ohio State University 1929; M.S. Ohio State University 1933; Ph.D. University of California 1958, Economic and Engineering Factors in Agricultural Processing Plant Design.

FRED BRADLEY SAUNDERS, B.S.A. University of Georgia 1948; M.S.A. University of Georgia 1949; Ph.D. Iowa State College 1958, Farm and Nonfarm Adjustment Opportunities for Specified Resource Situations for Families on Small Owner-Operated Farms, Piedmont Area, Georgia.

ROBERT BENTON SCHWART, B.S. Ohio State University 1947; M.S. Ohio State University 1949; Ph.D. Ohio State University 1958, The Relation of Variations in Education to the Decision-Making of Farmers.

ROBERT SINCLAIR, B.S. University of Vermont 1944; M.S. University of Vermont 1954; Ph.D. Michigan State University 1958, An Evaluation of Theories Relevant to Insurance Purchases Through An Analysis of the Insurance Programs of Vermont Farmers.

HAR SWARUP SINGH, B.S., A.S. College, Lakhaoti, Bulandshahr, U. P., India, 1948; M.S. Government Agricultural College, Kanpur, U.P., India, 1950; Ph. D. North Carolina State College 1958, Evaluation of Alternative Income Opportunities for Farm Operators in Macon County, North Carolina.

WESLEY GEORGE SMITH, B.S.A. University of Manitoba, 1951; M.S. University of Minnesota 1953; Ph.D. Iowa State College 1958, Dynamic Linear Programming of Conservation Alternatives, Including Household Consumption.

STANLEY W. SPANGLER, B.S. Kirksville State Teachers College 1938; M.S. University of Missouri 1953; Ph.D. University of Missouri 1958, The Economics of Fertilizer Use and Other Input-Output Data in Corn Production on the Putnam Soils of Missouri.

DANIEL AUGUSTUS SWOPE, JR., B.S. Pennsylvania State University 1942; M.S. Cornell University 1943; Ph.D. Pennsylvania State University 1958, Factors Associated with the Use of Milk as a Beverage by Adults.

MORRIS H. TAYLOR, B.S. Utah State Agriciultural College 1937; M.A. University of Wisconsin 1938; Ph.D. University of Wisconsin 1958, Basic Considerations for Developing an Extension Marketing Program in the Western Livestock Industry.

HARLON DWAIN TRAYLOR, B.S. Southwestern Louisiana Institute 1950; M.S. Louisiana State University 1955; Ph.D. Cornell University 1958, Some Effects of Film Packages and Uniform Sizing on Retail Potato Sales.

DEAN F. TUTHILL, B.S. Cornell University 1949; M.S. University of Illinois 1954; Ph.D. University of Illinois 1958, Selection and Comparison of Optimum Organizations for Farms in the Lincoln Area of Southern Illinois with Emphasis on Dairying.

MARTIN V. WAANANEN, B.S. Michigan State College 1950; M.S. University of Illinois 1952; Ph.D. University of Illinois 1958, Economic Effects of Bulk Milk Handling.

JERRY G. WEST, B.A. Oklahoma A & M College 1952; M.S. Oklahoma A & M College 1955; Ph.D. Michigan State University 1958, Estimates of Income Elasticity From Consumer Panel Data.

CLIFTON REGINALD WHARTON, A.B. Harvard University 1947; A.M. Johns Hopkins University 1948; A.M. University of Chicago 1956; Ph.D. University of Chicago 1958, A Case Study of the Economic Impact of Technical Assistance: Capital and Technology in the Agricultural Development of Minas Gerais, Brazil.

CHARLES PEAIRS WILSON, B.S. Kansas State College 1938; M.S. Kansas State College 1941; Ph.D. University of California 1958, An Economic and Statistical Analysis of Beef Cattle Marketing and Prices.

HSIANG HSING YEH, B.S. National Taiwan University, Formosa, 1951; M.S. Michigan State University 1955; Ph.D. Iowa State College 1958, Fertilizer Demand Functions of United States Farmers.

JOSEPH ZAREMBA, S.B. University of Washington 1948; M.F. State University of New York 1951; Ph.D. Harvard University 1958, Some Problems in Forecasting Future Wood Requirements.

RICHARD B. ZOLLER, B.S. University of Minnesota 1953; Ph.D. University of Minnesota 1958, The Vertical-Block Budgeting System, A New Farm Planning Technique.

Preliminary

PROGRAM OUTLINE FOR ANNUAL MEETING

AMERICAN FARM ECONOMIC ASSOCIATION

CORNELL UNIVERSITY
AUGUST 23-26, 1959

SUNDAY, AUGUST 23

Afternoon:	Registration
	Executive Committee Meeting
	Student Activities Committee
Evening:	Coffee hour honoring Charter Members, Fellows, and Past Presidents

MONDAY, AUGUST 24

Morning:	General session
	Commemoration of the fiftieth year
	Address by President-Elect
Afternoon:	Major section meetings
	Competition in the food trade
	Interregional economics
	Student debates, first round
Evening:	Barbecue
	Executive Committee

TUESDAY, AUGUST 25

Morning:	Annual business meeting
	Student debates, second round
	Student public speaking contest
	Major section meetings
	Status of agriculture in maintaining competition
	Interregional competition in agriculture
	Market Structure and economic development
	Encouraging fundamental research in agricultural economics
	Revised index numbers of prices received and paid by farmers

Afternoon:	Section meetings
	Agriculture in underdeveloped regions
	Student debates, third round
	Efficiency models in studies of interregional competition
	Graduate student papers
	Impact of urban development on agriculture
	Regional consumption patterns
	Rural development
	Sociological aspects of farm integration
	Research approaches to food market structure studies
	Farm management
	Forest economics
	Agricultural data
	Undergraduate training in agriculture
	Post-graduate instruction for foreign students
Evening:	Awards program

WEDNESDAY, AUGUST 26

Morning:	Joint session with Rural Sociological Society
	Economic and Sociological implications of internal migration in the United States
	The implications of rural youth migration and occupational mobility to agriculture
	Impact on agricultural society and policy

85

SKI

SON
JR.
ELS
es
KAL
OND
LEY
ar
NES

NON

SKY

SON
AGE
ait
EAL
BOL
of
ING
ILL
NER
ACE
LSH
LLIS

her

erg

han

rag

tzer

son

sell

tion
ada
per
in

Wil
Geo
Dar
And
Har
Her
Geo
Joh
Her
Wa
Ber
The
Ed
Mi
Th
Joh
Le
He
Ha
Os
Joh
Ho
W
W

THE AMERICAN
FARM ECONOMIC ASSOCIATION

PAST PRESIDENTS

William J. Spillman 1910-12
George F. Warren 1913
Daniel H. Otis 1914
Andrew Boss 1915
Harcourt A. Morgan 1916
Henry W. Jeffers 1917
George A. Billings 1918
John F. Fain 1919
Henry C. Taylor 1920
Walter F. Handschin 1921
Benjamin H. Hibbard 1922
Thomas P. Cooper 1923
Edwin G. Nourse 1924
Milburn L. Wilson 1925
Thomas N. Carver 1926
John I. Falconer 1927
Lewis C. Gray 1928
Henry E. Erdman 1929
Harold C. M. Case 1930
Oscar C. Stine 1931
John D. Black 1932
Howard R. Tolley 1933
William I. Myers 1934
Waldo E. Grimes 1935
Joseph S. Davis 1936
Oscar B. Jesness 1937
Ernest C. Young 1938
Irving G. Davis 1939
Foster F. Elliott 1939
Hugh B. Price 1940
Murray R. Benedict 1941
George S. Wehrwein 1942
Sherman E. Johnson 1943
Eric Englund 1944
Lawrence J. Norton 1945
Frederick V. Waugh 1946
Asher Hobson 1947
William G. Murray 1948
Oris V. Wells 1949
Warren C. Waite 1950
Forrest F. Hill 1951
George H. Aull 1952
Harry R. Wellman 1953
Thomas K. Cowden 1954
Joseph Ackerman 1955
Karl Brandt 1956
H. Brooks James 1957
Harry C. Trelogan 1958

Editorial communications including manuscripts submitted for publication or inquiries concerning the *Journal* should be addressed to Robert L. Clodius, Department of Agricultural Economics, University of Wisconsin, Madison 6, Wisconsin. Communications concerning books for review and books, bulletins and other publications submitted for announcement in the *Journal*, should be addressed to George G. Judge, Department of Agricultural Economics, Oklahoma State University, Stillwater, Oklahoma.

Applications for membership, changes in address, or inquiries regarding the general affairs of the Association should be addressed to C. Del Mar Kearl, Department of Agricultural Economics, Cornell University, Ithaca, New York.

Nonmember subscription rates $9 annually.

GEORGE BANTA COMPANY, INC., MENASHA, WISCONSIN